United States Air Force
611th Air Support Group/
Civil Engineering Squadron

Elmendorf AFB, Alaska

Final
(Revision 1)

Remedial Investigation and Feasibility Study

Barter Island Radar Installation, Alaska

Volume 1 of 2
(Includes Appendices A through C)

05 JANUARY 1996

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Prepared by:

ICF Technology Incorporated

05 JANUARY 1996

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PREFACE

This report presents the findings of Remedial Investigations and Feasiblity Studies at sites located at the Barter Island radar installation in northern Alaska. The sites were characterized based on sampling and analyses conducted during Remedial Investigation activities performed during August and September 1993. This report was prepared by ICF Technology Incorporated.

This report was prepared between January 1995 and January 1996. Mr. Samer Karmi of the Air Force Center for Environmental Excellence was the Alaska Restoration Team Chief for this task. Dr. Jerome Madden and Mr. Richard Borsetti of the 611 CES/CEVR were Remedial Project Managers for this project.

Approved:

Thomas McKinney
Program Director
ICF Technology Incorporated

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NOTICE

This report has been prepared for the United States Air Force (Air Force) by ICF Technology Incorporated for the purpose of aiding in the implementation of final remedial actions under the Air Force Installation Restoration Program (IRP). As the report relates to actual or possible releases of potentially hazardous substances, its release prior to an Air Force final decision on remedial action may be in the public's interest. The limited objectives of this report and the ongoing nature of the IRP, along with the evolving knowledge of site conditions and chemical effects on the environment and health, must be considered when evaluating this report, since subsequent facts may become known which may make this report premature or inaccurate. Acceptance does not mean that the United States Air Force adopts the conclusions, recommendations or other views expressed herein, which are those of the contractor only and do not necessarily reflect the official position of the United States Air Force.

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EXECUTIVE SUMMARY

BACKGROUND

The United States Air Force (Air Force) has prepared this Remedial Investigation/Remedial Study (RI/FS) report as part of the Installation Restoration Program (IRP) to present results of RI/FS activities at 14 sites at the Barter Island radar installation. The IRP provides for investigating, quantifying, and remediating environmental contamination from past waste management activities at Air Force installations throughout the United States. The IRP is a four-phase program that approximates the remedial investigation (RI) and corrective action program used by the U.S. Environmental Protection Agency (EPA) for addressing contaminated sites that may pose a risk to human health or the environment.

The Air Force initiated IRP activities at the Barter Island radar installation in 1980 in response to the Department of Defense's (DOD's) commitment to identify past waste disposal sites and eliminate hazards to public health. The initial Phase I conducted by the Air Force concluded that past waste management activities at the installation may have resulted in adverse environmental impacts at several sites (CH2M Hill 1981).

In 1986, the Air Force initiated Phase II activities designed to confirm and quantify the nature and extent of environmental impairment identified during Phase I. Phased II activities involved limited field investigations of specific sites that were identified in the Phase I Installation Assessment/Record Search activities (Dames and Moore 1986, 1987).

By 1988, the Air Force had replaced the phased approach with an approach similar to the RI/FS activities of EPA. The Air Force conducted RI/FS Stage 3 activities organized around five sites at the Barter Island installation in June 1988 (Woodward-Clyde 1988a). Activities included soil, surface water and sediment sampling, possible removal actions, hydrologic assessment, a demographic survey, an endangerment assessment (health risk assessment), and a Feasibility Study (FS) for the remedial alternatives. The Stage 3 Final Report of September 1990 summarized the results of the RI and supported a no further action decision (Woodward-Clyde 1990b).

The Air Force's IRP Decision Document for Barter Island of October 1990 (Woodward-Clyde 1990e) concluded that no further action was needed at the five sites. However, correspondence from Alaska Department of Environmental Conservation (ADEC) personnel to Air Force personnel in November 1991 (ADEC 1991) disagreed with the no further action conclusion. The correspondence stated that further investigation was needed and that corrective action appeared necessary because of improper waste disposal practices and other issues.

In addition, two non-IRP environmental assessments have been conducted at the Barter Island radar installation. An environmental site assessment was conducted at the Weather Station Building in 1992 (Shannon and Wilson 1992), and an environmental assessment was prepared in 1986 for a proposed prototype Short Range Radar Station (Metcalf and Eddy 1986).

Interim remedial actions were conducted by the Air Force in 1992 at the Old Landfill, Current Landfill, and Contaminated Ditch. Interim actions included construction of a seawall at the Old Landfill and general cleanup of waste and debris at all three of the sites.

The Air Force initiated RI/FS activities at the Barter Island radar installation in the summer of 1993. During the initial scoping activities, which included record searches, personnel interviews, and physical inspection of the installation, the Air Force and ADEC personnel concluded that 14 sites warranted investigation under the IRP. This document is a detailed presentation of RI activities and provides conclusions and recommendations for addressing environmental conditions at the 14 Barter Island sites. Remedial actions are recommended at four of the sites, and further characterization is recommended at one site. No further action is recommended at the remaining nine sites.

INSTALLATION DESCRIPTION

The Barter Island radar installation is located on an island at 70°08'N, 143°35'W, approximately 75 miles west of the Canadian border on the Arctic Coastal Plain, adjacent to the native village of Kaktovik (Figure 1-1, page 1-7). The facility is established in 4,353 acres of low-lying tundra on the northern border of the Alaska National Wildlife Refuge (ANWR). The maximum elevation on Barter Island is 55 feet above mean sea level (MSL), and drainage is radially away from the high points. The Barter Island installation is situated adjacent to the northern coast, on a relatively flat area below a gradual slope. Upslope from the installation is a freshwater lake used as a drinking supply for the station and Kaktovik village. Kaktovik is located east of the installation, adjacent to Kaktovik Bay (Figure 1-2, page 1-9).

Barter Island radar installation, also known as BAR-M, was the prototype Distant Early Warning (DEW) Line station and has been in active use since 1952. The installation consists of two module trains, a power plant, garages, warehouses, a hangar, a weather building, and radar and communication structures. Approximately seven contractor personnel currently operate and maintain the facility.

Average daily temperatures range from 46°F to -20°F annually. Precipitation at Barter Island averages seven inches per year. Permafrost at the installation area is up to 1,300 feet thick. Due to the permafrost, polygonal surface patterns are abundant.

The hydrology of the station is controlled by the relatively low topography and permafrost. Even with the low precipitation rates, the tundra is predominantly swampy. Small streams drain the several large and small lakes and swampy land occurring around the installation.

Barter Island is predominantly covered by a thin tundra mat, beneath which is a layer of sand and loess (wind blown silt) approximately two to three feet thick. Underlying these deposits are lenses and layers of marine and alluvial clay, silt, sand, and sandy gravel. Coastal erosion rates of 7.9 feet per year have been reported.

The vegetative habitat types on Barter Island support a variety of wildlife. The island provides an important habitat to birds, mammals, and fish.

PROJECT ACTIVITIES

The Air Force conducted RI/FS field activities at 14 sites at the Barter Island radar installation during 1993. The objectives of the Barter Island RI/FS are to confirm the presence or absence of chemical contamination of the environment at the installation; define the extent and magnitude of confirmed chemical releases; gather adequate data to determine the magnitude of potential risks to human health and the environment; and gather adequate data to identify and select the appropriate remedial actions for sites where apparent risks exceed acceptable limits.

The RI field activities were carried out in a three-phase approach. The three phases, installation presurvey, reconnaissance, and RI field activities, allowed contractor personnel to confirm the location of areas of environmental concern and identify sampling location before conducting RI field activities. Fourteen sites investigated during the RI activities include:

- Old Landfill (LF01)
- Petroleum, Oils, and Lubricants (POL) Catchment (LF03)
- Current Landfill (LF04)
- Contaminated Ditch (SD08)
- Old Runway Dump (LF12)
- Heated Storage (SS13)
- Garage (SS14)
- Weather Station Building (SS15)
- White Alice Facility (SS16)
- POL Tanks (ST17)
- Fuel Tanks (ST18)
- Old Dump Site (LF19)
- Bladder Diesel Spill (SS20)
- JP-4 Spill (SS21)

The site locations are shown on Figure 1-3 (page 1-11).

The RI field activities were conducted from mid-August through early September of 1993. The RI was conducted in conjunction with RIs at seven other radar installations located throughout northern Alaska. Sixteen contractor employees were stationed in Alaska for the duration of the RI. Sampling activities at the Barter Island radar installation included collection of surface and subsurface soil samples with hand tools and collection of surface water, sediment, and seep samples from drainages adjacent to potentially contaminated discharge areas.

A total of 190 samples was collected during the 1993 RI activities at Barter Island. These included soil, sediment, and surface water samples collected from the 14 sites as well as samples for quality assurance/quality control (QA/QC) and to establish background levels. A summary of the samples collected is presented in Table ES-1.

Analyses of samples collected during RI activities were conducted by a fixed laboratory in Anchorage, Alaska, and a temporary laboratory set up at Barrow, Alaska. Laboratory analyses conducted by the temporary laboratory were conducted on a quick turnaround basis. Analyses

TABLE ES-1. SUMMARY OF REMEDIAL INVESTIGATION SAMPLING

SITE	MEDIUM	NUMBER OF ENVIRONMENTAL SAMPLES
Old Landfill (LF01)	Soil/Sediment	4
	Surface Water	8
POL Catchment (LF03)	Soil/Sediment	13
	Surface Water	3
Current Landfill (LF04)	Soil/Sediment	6
	Surface Water	5
Contaminated Ditch (SD08)	Soil/Sediment	17
	Surface Water	4
Old Runway Dump (LF12)	Soil/Sediment	3
Heated Storage Building (SS13)	Soil/Sediment	13
	Surface Water	5
Garage (SS14)	Soil/Sediment	8
	Surface Water	1
Weather Station Building (SS15)	Soil/Sediment	8
White Alice Facility (SS16)	Soil/Sediment	11
POL Tanks (ST17)	Soil/Sediment	4
Fuel Tank (ST18)	Soil/Sediment	12
	Surface Water	1
Old Dump Site (LF19)	Soil/Sediment	10
	Surface Water	1
Bladder Diesel Spill (SS20)	Soil/Sediment	5
	Surface Water	2
JP-4 Spill (SS21)	Soil/Sediment	5
Total Environmental Analyses	Soil/Sediment	125
	Surface Water	32
QA/QC SAMPLES		
Ambient Condition Blanks	Water	3
Equipment Blanks	Water	9
Trip Blanks	Water	5
Replicates/Duplicates	Soil/Sediment	13
	Surface Water	2
Total Samples	Soil/Sediment	138
	Surface Water	52

conducted in Anchorage, Alaska, included primarily standard turnaround but also a few quick turnaround analyses.

The Air Force conducted a risk assessment once the data had been validated and compiled. The purpose of the risk assessment was to evaluate the human and ecological health risks that may be associated with chemicals released to the environment at the 14 sites investigated during the RI. The risk assessment characterizes the probability that measured concentrations of hazardous chemical substances will cause adverse effects in humans or the environment in the absence of remediation. The risk assessment will be used in conjunction with state and federal standards and/or guidance to determine if remediation (site cleanup) is necessary. The Barter Island Risk Assessment (U.S. Air Force 1996) was submitted under separate cover.

CHRONOLOGY OF ACTIVITIES

Project scoping documents were submitted between June and August 1993 for review by Air Force Center for Environmental Excellence (AFCEE) and regulatory agencies. These documents include the Work Plan, Sampling and Analysis Plan, Health and Safety Plan, and Community Relations Plan for seven DEW Line installations and Cape Lisburne. The installation Presurvey and the Reconnaissance trips were conducted in order to provide the information necessary to conduct the RI/FS activities. The Presurvey was conducted in May 1993 by a small group of contractor employees accompanied by Air Force representatives.

The Reconnaissance trip was completed in June 1993 by contractor employees, and AFCEE and ADEC representatives. RI field activities were conducted from mid-August through early September 1993. Sampling was conducted from the areas of least contamination to areas of increasing contamination. The sequence of sampling from least to most contaminated was based on previous sampling data, field screening, and visual observations. Field screening was used to assist in determining the areal extent of contamination and sampling locations. Where quick turnaround sample analyses indicated information gaps about the areal extent of contamination, or exposure point concentrations for potentially exposed populations were not defined, a second round of samples was collected and analyzed.

SUMMARY OF REMEDIAL INVESTIGATION/FEASIBILITY STUDY

The following paragraphs describe RI activities conducted at the 14 sites that are the focus of this report and summarize the findings of the RI. Summaries of human health and ecological risks posed by chemicals detected at each site are included. The remedial alternatives are presented for the sites recommended for cleanup; however, the recommended remedial alternatives presented throughout the report shall be viewed as a general approach rather than a specific action because there are uncertainties regarding the effectiveness of the remedial alternatives in the unusual environment of the North Slope, future land use, and availability and timing of funding to perform remedial actions. As a result, the recommended alternatives identified in this report should not be considered the final word. Instead, they should be considered the best available approach pending treatability testing and remedial design. The actual remedial action implemented may differ from those recommended in this report as more

information and technological advances become available. The evaluation of remedial alternatives is presented in the FS, Section 6.0 of this report.

Old Landfill (LF01). This site is located adjacent the Beaufort Sea at the northernmost boundary of Barter Island (Figure 3-1, page 3-11). The Old Landfill was operational between 1956 and 1978 and occupies two to three acres. Historically, the Old Landfill received all wastes generated at the station and the nearby village of Kaktovik. In 1992, the Air Force conducted interim remedial actions at the site that included compaction, grading, removal of drums, installation of a gravel cap, and a general cleanup of exposed waste. A seawall was constructed on the north end of the landfill in 1992 to prevent erosion of the landfill by coastal wave processes.

Sampling and analyses have determined that the Old Landfill (LF01) site is not significantly contaminated. Only relatively low levels of organic contaminants were detected at the site, and metals concentrations slightly above background levels were the only chemicals of concern (COCs) identified at the site. Migration of contaminants from the site appears minimal based on the surface water samples collected in drainage pathways on three sides of the landfill.

The risk assessment concluded that risks posed to human and ecological receptors by site contaminants are minimal given current or future site uses. A potential noncancer hazard was identified in surface water due to the levels of manganese detected. This potential hazard is based on a future scenario in which the site surface water would be used as a drinking water supply. Even using the conservative future scenario, the potential human health risks at the site are not of a magnitude that normally requires remedial action. The Ecological Risk Assessment (ERA) concluded that the overall potential risks presented by site contaminants are minimal. Therefore, considering the findings of the risk assessment, remediation of the site is not necessarily warranted.

Based on the RI sampling and analyses, risk assessment and current site uses, remedial actions are not warranted at the site. No chemicals detected at the site exceed applicable or relevant and appropriate requirements (ARARs), and no significant human health or ecological risks were identified at the site. Therefore, the Old Landfill (LF01) site is recommended for no further action.

POL Catchment (LF03). This site is an almost rectangular, tundra area surrounded by a gravel berm (Figure 4-1, page 4-11). The site is located north of the module trains and directly east of the POL Tanks (ST17). The tundra area within the gravel berm is approximately 200 feet by 130 feet. The east portion of the bermed area consists of tundra and is dominated by a large pond. A small portion of the west side of the site consists of gravel, and there is a small stained area in the gravel at the base of the western berm. The POL Catchment serves as a secondary containment unit for petroleum hydrocarbons from the POL Tanks resulting from tank leaks and fuel spills. The POL Tanks area is a bulk fuel storage area for Arctic grade diesel fuel.

Sampling and analyses have determined that the POL Catchment (LF03) site is contaminated primarily with petroleum hydrocarbons. The contaminated areas are soil/sediment and surface water within the bermed portion of the site. In addition, a small stained area of gravel located in the western portion of the site is contaminated with petroleum hydrocarbons. The likely

sources of contamination are spills and/or leaks of diesel fuel from the tank farm just to the west of the site.

Migration of contaminants from the site appears to have occurred to a limited degree through a culvert that leads from the catchment basin to the tundra area to the east. Relatively low levels of diesel range petroleum hydrocarbons (DRPH) were detected in soil/sediments and surface water in samples from this tundra area. The area drains to the Contaminated Ditch site, and no contaminants were detected in soil/sediment and surface water samples from the down-gradient areas of the ditch.

The risk assessment concluded that risks posed to human and ecological receptors by site contaminants are minimal given current site uses. Under a future scenario, using the surface water in the catchment basin as a drinking water supply results in a potential risk to human health. This risk, however, is not of a magnitude that normally requires remedial action. Therefore, under current site conditions and considering the findings of the risk assessment, remediation of the site is not necessarily warranted.

Levels of petroleum compounds (primarily diesel) detected at the site significantly exceed ADEC guidance cleanup levels, and migration of contaminants has occurred. Therefore, the site is recommended for remedial action. The contaminated area at the site consists of 5 cubic yards of gravel and 2,500 cubic yards of tundra. Passive bioremediation is the recommended alternative for remediation of both the gravel and tundra areas of the site.

Current Landfill (LF04). This site is located northwest of the module trains and southwest of the Old Landfill (LF01) (Figure 3-2, page 3-33). The Current Landfill covers approximately two acres and receives all wastes generated at the installation. It received waste from the nearby village of Kaktovik from 1978 to 1992 before the village constructed its own landfill; the use of the site by Kaktovik community residents was uncontrolled. It reportedly received household waste, human and animal waste, drums and other maintenance wastes. Currently the disposal of wastes at the site by station personnel is in accordance with appropriate regulations. In 1992, the Air Force conducted an interim remedial action at the site that consisted of a general cleanup of debris at the site.

Sampling and analyses have determined that there is no significant contamination at the Current Landfill (LF04) site; only relatively low levels of contaminants were detected. The suspected source of contaminants is previous waste disposal practices at the Current Landfill and/or areas to the north of the landfill. The village of Kaktovik is no longer using the landfill for disposal of wastes, so disposal of potential contaminants at the north end of the landfill has been discontinued.

Migration of contaminants from the site appears minimal based on the surface water samples collected in drainage pathways leading from the site.

The risk assessment concluded that risks posed to human and ecological receptors by site contaminants are minimal given current or future site uses. A potential noncancer hazard was identified in surface water due to manganese. This potential hazard is based on a future

scenario in which the site surface water would be used as a drinking water supply. Even using the conservative future scenario, the potential human health risks at the site are not of a magnitude that normally requires remedial action. Based on the RI sampling and analyses, risk assessment and current site uses, remedial actions are not warranted at the site. No significant human health or ecological risks were identified at the site. Therefore, the Current Landfill (LF04) site is recommended for no further action.

Contaminated Ditch (SD08). This site is located approximately 100 yards northeast of the module trains. The Contaminated Ditch is a large, deep, natural eroded gully running to the north and discharging to the Beaufort Sea (Figure 3-3 and 3-4, pages 3-53 and 3-55). The village of Kaktovik was located west of the ditch from 1952 to 1964. The ditch was suspected of containing petroleum hydrocarbons from a ruptured fuel line near the warehouse area north of the module trains. In 1992, the Air Force conducted interim remedial actions at the site that included a general cleanup of the ditch and removal of exposed metal debris.

Sampling and analyses have determined that there is no significant contamination at the Contaminated Ditch (SD08) site. With a few exceptions, only relatively low levels of contaminants were detected at the site. Upgradient areas in the vicinity of the warehouses had petroleum hydrocarbons at levels exceeding ADEC cleanup guidelines for gravel pads. A definitive hot spot or source area, however, was not identified. There were no significant contaminants detected downgradient in the ditch, and most surface water samples were non-detect. The suspected source of the contamination in the upgradient portion of the site is a reported diesel spill near warehouse, Building WH1.

Migration of contaminants appears to have occurred on the gravel pad areas to the east of the suspected source area. Migration to the incised stream and downgradient portion of the Contaminated Ditch appears minimal, and the low levels detected in the ditch may be from other upgradient sites.

The risk assessment concluded that risks posed to human and ecological receptors by site contaminants are minimal given current or future site uses. A potential carcinogenic risk was identified in site soils based on the maximum concentrations of gasoline range petroleum hydrocarbons (GRPH) and beryllium detected. This risk is based on a future residential scenario and soil ingestion. Even using the conservative future scenario, the potential human health risks at the site are not of a magnitude that normally requires remedial action.

Based on the RI sampling and analyses, risk assessment and current site uses, remedial actions are not warranted at the site. Migration of contaminants appears minimal, and no significant human health or ecological risks were identified at the site. Therefore, the Contaminated Ditch (SD08) site is recommended for no further action.

Old Runway Dump (LF12). This site is located on the northeast corner of Barter Island, east of the runway (Figure 3-5, page 3-69). It is a two-acre area suspected of receiving all wastes generated during the construction of the installation and for a short period thereafter. The site received construction debris, old vehicles, drums, and all other waste generated during this

period. The landfill has been closed since 1957 and reportedly was cleaned up between 1979 and 1980.

Sampling and analyses have determined that the Old Runway Dump (LF12) is not contaminated; no contaminant was detected in site samples. The site is also subject to seasonal flooding by saltwater, and if contaminants were previously present, they were likely diluted by seawater. Since no contaminant was detected at the site, there appears to be no potential for contaminant migration, or risks posed by the site to human health or ecological receptors. Based on the RI sampling and analyses, the Old Runway Dump (LF12) site is recommended for no further action.

Heated Storage (SS13). This site is located southeast of the module trains and the power house (Figures 4-2 and 4-3, pages 4-29 and 4-31). The Heated Storage Building is approximately 80 feet by 40 feet and is used for vehicle maintenance and storage. The building is raised approximately three to four feet above the tundra and is bounded by a gravel pad on the north, south, and east sides. The floor drains within the building discharged directly to the tundra area below and may have received waste oils and other waste automotive fluids. The floor drains were sealed in July 1993 by the Air Force to prevent future release of contaminants.

Sampling and analyses have determined that the Heated Storage (SS13) site is contaminated with petroleum hydrocarbons (DRPH and GRPH), benzene, toluene, ethylbenzene, and xylene (BTEX) and low levels of solvents and polychlorinated biphenyls (PCBs). Some metals (inorganics) detected at the site at slightly elevated levels are also considered to be COCs. The contaminated media at the site are soil/sediment and surface water. The soil/sediment areas beneath the site building have the highest concentrations of contaminants. The likely source of contamination is the discharge of waste materials to floor drains in the building. Current waste management practices should prevent future releases of contaminants to the environment.

Migration of contaminants from the site appears to have occurred via a stream and culverts that lead from beneath the Heated Storage building to tundra areas. From the tundra area contaminants have migrated via a drainage pathway to the north. Contaminants detected in soil/sediment and surface water samples from these downgradient areas were similar to contaminants detected below the Heated Storage building; however, downgradient concentrations were lower.

The risk assessment concluded that risks posed to human and ecological receptors by site contaminants are minimal given current site uses. Under a future scenario, using the surface water in the drainage pathways from the site as a drinking water supply results in a potential risk to human health. This human health risk, however, is not of a magnitude that normally requires remedial action. The ERA concluded that the overall potential risks presented by site contaminants are low. Therefore, under current site conditions and considering the findings of the risk assessment, remediation of the site is not necessarily warranted.

Levels of petroleum compounds (primarily diesel and gasoline) detected in soil/sediment at the site significantly exceed ADEC cleanup guidance levels. In addition, contaminants have migrated downgradient of the site and have impacted soil/sediment and surface water. Therefore the site is being recommended for remedial action. The contaminated areas at the site include 110 cubic

yards of soil beneath the building, 50 cubic yards of gravel, and 232 cubic yards of tundra. The remedial action alternative recommended for beneath the building is in situ biosurfactants, and for gravel areas and tundra, passive bioremediation is the recommended alternative.

Garage (SS14). This site is located east of the powerhouse and north of the Heated Storage Building (Figure 4-4, page 4-55). The Garage is an approximately 90 feet by 30 feet building that is elevated approximately three feet above the tundra and surrounded by a gravel pad. The building is used for vehicle maintenance and storage and is connected to the module train by a corridor. The floor drains within the building discharged directly to the tundra beneath the structure and may have received vehicle maintenance wastes. The floor drains were sealed in July 1993 by the Air Force to prevent future release of contaminants.

Sampling and analyses have determined that the Garage (SS14) site is contaminated with petroleum hydrocarbons [DRPH, GRPH, and residual range petroleum hydrocarbons (RRPH)], BTEX, volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs), most of which are components of diesel fuel. The contaminated areas at the site include the disturbed tundra beneath the Garage building and gravel areas to the east and west of the Garage. Although the area beneath the building could not be sampled due to limited access, visual observations and samples collected at the ends of the building indicate the area beneath the Garage is contaminated. The likely source of contamination is liquid waste materials discharged to floor drains in the building. These floor drains were sealed in 1993, and current waste management practices should prevent future releases of contaminants at the site.

Migration of contaminants from the site appears to have occurred via culverts that lead from beneath the Garage building to gravel areas to the east and west. Contaminants detected in these gravel areas may have migrated to the drainage pathways associated with the Heated Storage site. A discussion of the downgradient pathways and the contaminants detected is presented with the Heated Storage site, Section 4.2.

The risk assessment concluded that risks posed to human and ecological receptors by site contaminants are minimal given current site uses. Based on the human health risk assessment, the potential human health risks at the site are not of a magnitude that normally requires remedial action. The ERA concluded that the overall potential risks presented by site contaminants are low. Therefore, under current site conditions and considering the findings of the risk assessment, remediation of the site is not necessarily warranted.

Levels of petroleum compounds (primarily diesel and gasoline) detected in soil/sediment at the site exceed ADEC cleanup guidance levels. In addition, site contaminants have migrated downgradient, have impacted gravel areas and have probably contributed to the contaminated tundra areas associated with the Heated Storage (SS13) site. Therefore, the site is being recommended for remedial action. The contaminated areas at the site include 110 cubic yards of soil beneath the building and 150 cubic yards of adjoining gravel. The remedial action alternative recommended for soil beneath the building is in situ biosurfactants. For gravel areas, the recommended remedial alternative is passive bioremediation.

Weather Station Building (SS15). This site is located northwest of the module trains and southwest of the Current Landfill (LF04) (Figure 3-6, page 3-81). The Weather Station Building is approximately 30 feet by 30 feet and is elevated approximately five feet above the center of the gravel pad area. A 1,200 gallon above ground fuel storage tank is located at the northeast corner of the building. The diesel tank has leaked over the years, and a stained area was observed just below the tank fittings.

Sampling and analyses have determined that the Weather Station Building (SS15) site is contaminated with petroleum hydrocarbons (DRPH and GRPH) and low levels of BTEX. The contaminated areas at the site are in the gravel pad below and downgradient of the diesel storage tank. The source of contamination is a spill and/or leak in pipe fittings on the diesel tank.

Migration of contaminants from the site appears to be minimal. Samples collected at the edge of the gravel pad were near non-detect, indicating the tundra adjoining the gravel pad has not been impacted by the migration of contaminants.

The risk assessment concluded that risks posed to human and ecological receptors by site contaminants are minimal given current site uses. The potential human health risks at the site are not of a magnitude that normally requires remedial action. Based on RI sampling and analyses, risk assessment and current site uses, remedial actions are not warranted at the site. Chemicals detected at the site did not pose significant human health or ecological risks; therefore, the Weather Station Building (SS15) site is recommended for no further action.

White Alice Facility (SS16). This site is located 1,600 feet south of the module trains, and was a transmission and receiving unit for the station (Figure 4-5, page 4-75). The site consists of a radio relay building and two large White Alice "billboards" that look like outdoor movie screens. It was suspected that dielectric fluids containing PCBs were discharged to the surface soils in small quantities during maintenance of the unit equipment.

Sampling and analyses have determined that the White Alice Facility (SS16) site is contaminated with Aroclor 1254, a group of PCBs. The contaminated area at the site is in the gravel pad adjacent to a concrete pad on which a transformer is located. The likely source of contamination is a former spill and/or leak of transformer fluid. Currently, the transformer contains non-PCB fluids.

Migration of contaminants from the site appears to have been minimal. Contaminated gravel appears to be limited to approximately sixteen square feet to the south and east of the concrete transformer pad. The potential for migration of contaminants is not anticipated as the site is relatively flat and PCBs tend to bind tightly with soil particles.

The risk assessment concluded that risks posed to human and ecological receptors by site contaminants are minimal given current site uses. A potential human health risk was identified based on levels of Aroclor 1254 at the site; however, the risks and hazards were calculated conservatively based on a future residential scenario and are probably overestimated. Therefore,

under current site conditions and considering the findings of the risk assessment, remediation of the site is not necessarily warranted.

Levels of PCBs detected in gravel at the site exceed regulatory cleanup levels and can potentially bioaccumulate in the environment. Therefore, the site is being recommended for remedial action. The contaminated area at the site consists of approximately two cubic yards of gravel. The remedial action alternative recommended for the site is excavation and offsite incineration.

POL Tanks (ST17). This active site is a bulk fuel storage area for arctic grade diesel fuels located north of the module trains and south of the active sewage lagoon (Figure 3-7, page 3-93). The site consists of six large, approximately 200,000 gallon, above ground tanks and associated piping and pumphouses, each contained inside a currently lined berm. The POL Tanks site was investigated as a possible source area of the POL Catchment (LF03).

Sampling and analyses have determined that the POL Tanks (ST17) site is not significantly contaminated. Petroleum hydrocarbons were detected in two sediment samples collected north of the POL Tanks below the high water mark of the sewage lagoon. The chemicals may be associated with the past disposal practices at the sewage lagoon. For many years the sewage lagoon received wastes from the radar installation and the village of Kaktovik. No contaminants were detected in other samples collected from the site, and there were no visual signs of spills or leaks in the tank farm area.

The risk assessment concluded that risks posed to human and ecological receptors by site contaminants are minimal given current or future site uses. Based on the RI sampling and analyses, risk assessment and current site uses, remedial actions are not warranted at the site.

Both the POL Tanks and the sewage lagoon are active compliance sites, and ADEC has recommended that the POL Tank site be removed from the list of IRP sites at this installation. Any future spills or leaks from the site will be handled as compliance issues. Therefore, the POL Tanks (ST17) site is recommended for no further action.

Fuel Tanks (ST18). This site is an active tank farm located inside a lined berm approximately 300 feet east of module train B (Figure 3-8, page 3-103). The Fuel Tanks consist of six 10,000 gallon above ground fuel tanks that contain vehicle fuel. Four tanks contain motor vehicle gasoline (MOGAS) and two tanks contain diesel. The tanks are used to fuel vehicles and heavy equipment used at the installation.

Sampling and analyses have determined that there is no significant contamination at the Fuel Tanks (ST18) site. Relatively low levels of petroleum hydrocarbons were detected in only two of thirteen site samples. No contaminants were detected in surface water samples, indicating there is no migration of contaminants from the site. The likely sources of the low levels of petroleum hydrocarbons at the site are small incidental fuel spills during vehicle refueling operations.

The risk assessment concluded that no COCs were present at the site; therefore, no evaluation of risk was conducted at the site. Other sites with higher concentrations of the same chemicals, however, were evaluated and determined not to pose a risk to human health or the environment.

Based on the RI sampling and analyses, risk assessment and current site uses, remedial actions are not warranted at the site. The Fuel Tanks site is an active compliance site and ADEC has recommended that it be removed from the list of IRP sites at this installation. Any future spills or leaks from the site will be handled as compliance issues. Therefore, the Fuel Tanks (ST18) site is recommended for no further action.

Old Dump Site (LF19). This site consists of several acres of mostly tundra located northeast of the module trains and east of the Contaminated Ditch (Figure 3-9, page 3-117). The village of Kaktovik was located at this site from 1952 to 1964. There are no obvious areas of contamination at the site, and it is uncertain as to whether this area was ever used as a dump site. Previous contractors reported the site was used as a storage area for materials scheduled for retrograde by sealift.

Sampling and analyses have determined that there is no significant contamination at the Old Dump Site (LF19). Petroleum hydrocarbons were detected in a few of the samples; however, no source area or widespread areas of contamination were identified. No organic contaminants were detected in a surface water sample collected from a drainage pathway leading away from the site. The chemicals detected at the site are possibly associated with the past disposal practices at the site. The village of Kaktovik was located on this site for approximately 12 years.

The risk assessment concluded that risks posed to human and ecological receptors by site contaminants are minimal given current or future site uses. Based on the RI sampling and analyses, risk assessment, and current site uses, remedial actions are not warranted at the site. Therefore, the Old Dump Site (LF19) site is recommended for no further action.

Bladder Diesel Spill (SS20). This site is a water-saturated tundra area with a thin gravel cover located west of module train B (Figure 3-10, page 3-133). The Bladder Diesel Spill area was historically a storage area for arctic grade diesel fuels. Site personnel indicated the possibility of a fuel spill in this area, so, although the bladder diesel tank has been removed, the area adjacent to the tank was suspected of containing petroleum hydrocarbons.

Sampling and analyses have determined that there is no significant contamination at the Bladder Diesel Spill (SS20) site. Only very low levels of contaminants were detected in two of the nine samples collected, and no COCs were identified at the site. The site was investigated because it was the location of a former bladder storage tank and reported diesel spill. The reported spills at the site either were minor in nature, or have bioremediated to near non-detect levels.

The risk assessment concluded that no COCs were present at the site; therefore, there is no apparent risk to human or ecological receptors.

Based on the RI sampling and analyses, risk assessment and current site uses, remedial actions are not warranted at the site. Therefore, the Bladder Diesel Spill (SS20) site is recommended for no further action.

JP-4 Spill (SS21). This site is located approximately 1,300 feet east of the main facility (Figure 4-6, page 4-87). This reported fuel spill was from a cut in an approximately six-inch diameter JP-4 fuel line approximately 100 yards below the JP-4 fuel tank. The fuel line runs from the JP-4 fuel tank to the hangar area. Site personnel indicated that a village diesel spill occurred upgradient of the JP-4 Spill area, and some of the product from the village spill may have migrated over this site.

Sampling and analyses have determined that the JP-4 Spill (SS21) site is contaminated with petroleum hydrocarbons (DRPH and GRPH) and low levels of BTEX. In addition, low levels of VOCs and SVOCs associated with JP-4 were detected in site soils. The contaminated area at the site is the gravel pad located along a section of the JP-4 pipeline. The source of contamination is probably a break in the JP-4 fuel line reported damaged during grading operations.

Migration of contaminants from the area of the break in the JP-4 line to downgradient locations appears to have occurred. A soil sample collected approximately 100 feet east of the suspected source area contained petroleum hydrocarbons. Because the pipeline is within a gravel drainage ditch, seasonal water flow may contribute to the potential migration of contaminants.

The risk assessment concluded that risks posed to human and ecological receptors by site contaminants are minimal given current or future site uses. The potential human health risks at the site are not of a magnitude that normally requires remedial action. Therefore, under current site conditions and considering the findings of the risk assessment, remediation of the site is not necessarily warranted.

Levels of petroleum compounds detected at the site exceed ADEC cleanup guidance levels, but the extent of contamination is not clearly defined. Therefore, the site is being recommended for additional sampling in order to more fully characterize the extent of petroleum hydrocarbon contamination.

CONCLUSIONS

To meet the Air Force's commitment to identify, quantify, and remediate waste disposal sites at installations throughout the United States, the prime contractor completed an RI/FS at fourteen sites at the Barter Island radar installation. The investigation was completed in accordance with the guidelines established in the Air Force's IRP. The RI/FS involved field investigations, sampling, and analysis.

Based on the RI sampling and data analyses and quantitative risk assessment, the Air Force has concluded there is no risk associated with observed conditions and recommends no further remedial action for 9 of the 14 sites. These sites, presented in Table ES-2, are the Old Landfill (LF01), Current Landfill (LF04), Contaminated Ditch (SD08), Old Runway Dump (LF12), Weather

Station Building (SS15), POL Tanks (ST17), Fuel Tanks (ST18), Old Dump Site (LF19) and the Bladder Diesel Spill (SS20). Further characterization is recommended at one site, the JP-4 Spill (SS21) (Table ES-3). At the four remaining sites, contaminant levels either may represent a potential risk to receptor populations or exceed ADEC cleanup guidance levels. It is recommended that remedial actions be conducted at these sites: POL Catchment (LF03), Heated Storage (SS13), Garage (SS14), and White Alice Facility (SS16). The remedial action alternatives recommended for these four sites are presented in Table ES-4.

ES-2. SITES RECOMMENDED FOR NO FURTHER ACTION

SITE NAME	SITE ID NUMBER
Old Landfill	LF01
Current Landfill	LF04
Contaminated Ditch	SD08
Old Runway Dump	LF12
Weather Station Building	SS15
POL Tanks	ST17
Fuel Tanks	ST18
Old Dump Site	LF19
Bladder Diesel Spill	SS20

TABLE ES-3. SITE RECOMMENDED FOR FURTHER CHARACTERIZATION

SITE NAME	SITE ID NUMBER
JP-4 Spill	SS21

TABLE ES-4. SITES RECOMMENDED FOR REMEDIAL ACTION

SITE NAME	SITE ID NUMBER	MEDIUM	RECOMMENDED REMEDIAL ALTERNATIVE
POL Catchment	LF03	Gravel	Passive Bioremediation
		Tundra	Passive Bioremediation
Heated Storage	SS13	Gravel	Passive Bioremediation
		Soil beneath structure	In Situ Biosurfactants*
		Tundra	Passive Bioremediation
Garage	SS14	Gravel	Passive Bioremediation
		Soil beneath structure	In Situ Biosurfactants*
White Alice Facility	SS16	Gravel	Excavation and Offsite Incineration

* In situ use of biosurfactants is contingent upon a successful treatability study. Containment is the next best alternative until the structure is removed.

1.0 INTRODUCTION

The Air Force has prepared this RI/FS report to present the results of RI/FS activities at 14 sites located at the Barter Island radar installation. The RI field activities were conducted at the Barter Island radar installation during the summer of 1993. The 14 sites at Barter Island were investigated because they were suspected of being contaminated with hazardous substances. The RI/FS was conducted in accordance with the requirements of the Air Force IRP. RI activities were conducted using methods and procedures specified in the RI/FS Work Plan, Sampling and Analysis Plan (SAP), and Health and Safety Plan (U.S. Air Force 1993a,b,c).

Section 1.0 of this report presents information concerning the objectives and implementation of the IRP, a description of the installation and its environmental setting at Barter Island, and brief background information on the 14 Barter Island sites. Project activities, including project objectives and scope, summaries of field and laboratory methods, methodologies for data evaluation and risk estimation, and a summary of background sampling, analytical results and migration pathways are described in Section 2.0. Section 3.0 documents the RI sampling and analysis results on a site-by-site basis for the eight sites where no further action is recommended, identifies potential migration pathways and receptors, summarizes the human health and ecological risks, and describes the conclusions and recommendations for each of these sites. Section 4.0 documents RI sampling and analyses results for the one site where further characterization may be warranted. Section 5.0 documents the RI sampling and analysis results on a site-by-site basis for the five sites where remedial actions may be warranted. These sections identify all ARARs, potential migration pathways, and receptors; summarize human health and ecological risks; and describe the conclusions and recommendations, including the recommended remedial alternative, for cleanup at each site. Section 6.0 presents the FS of potential remedial actions for the sites that may require cleanup.

The recommended actions for each of the sites, presented in Section 3.0 through 6.0, are preliminary. The actions for each site will be determined only after review of this RI/FS document and the Barter Island Risk Assessment (U.S. Air Force 1996) by regulatory agencies and interested parties. When agreement is reached between the Air Force and regulatory agencies as to the appropriate action for each site, a Decision Document will be prepared by the Air Force that presents the rationale for selecting a particular action. The Decision Document will also formally document that selection by ensuring appropriate Air Force and state and federal agency coordination and concurrence.

Appendix A provides references and a list of acronyms used in this document. Appendix B presents photographs of the Barter Island radar installation and sites. Appendix C is the Statement of Work describing the scope of the RI/FS activities at the Barter Island radar installation. Sample collection logs are presented in Appendix D; sample Chain-of-Custody forms are in Appendix E. Cross-reference tables and analytical data are presented in Appendix F, and Data Validation Reports are in Appendix G.

1.1 THE UNITED STATES AIR FORCE INSTALLATION RESTORATION PROGRAM

The Air Force IRP is the basis for assessment and response action on Air Force installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). The Air Force IRP is designed to identify, confirm/quantify, and remedy problems associated with past and present management of hazardous substances and hazardous wastes at Air Force facilities. CERCLA defines a hazardous substance in Section 101; the definition includes, as examples, any substance designated pursuant to Section 311(b)(2)(A) of the Federal Water Pollution Control Act (FWPCA), any element, compound, mixture, solution, or substance designated pursuant to Section 102 of CERCLA, and hazardous wastes identified pursuant to Section 3001 of the Resource Conservation and Recovery Act (RCRA). A hazardous waste, as defined in RCRA, "may pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of or otherwise managed" (Section 1004[2][B] of RCRA).

The DOD initiated the IRP in 1976 to identify, investigate, and mitigate environmental hazardous waste contamination that may be present at DOD facilities. In June 1980, DOD issued Defense Environmental Quality Program Policy Memorandum (DEQPPM) 80-6, requiring identification of past hazardous waste disposal sites at DOD agency installations. The Air Force implemented DEQPPM 80-6 in December 1980 and revised it in 1981.

Executive Order 12316 of 14 August 1981 directed the military to design its own program to remedy uncontrolled hazardous waste disposal sites consistent with the National Contingency Plan (NCP) established by CERCLA. In response to the directive, the DOD instructed its branches to identify hazardous waste disposal sites to which they contributed wastes, and to comply with environmental regulations at the installation level when implementing cleanup. DOD subsequently developed the basic IRP after which the Air Force IRP was modeled. DEQPPM 81-5 of 11 December 1981, implemented by Air Force Headquarters in January 1982, sets forth the basic authority and objectives for the Air Force programs.

The Superfund Amendments and Reauthorization Act of 1986 (SARA) augmented the scope and requirements of CERCLA and provided specific directives to federal facilities regarding investigation of waste disposal sites. Under SARA, technologies that provide permanent removal or destruction of hazardous wastes or contaminants are preferable to actions that only contain or isolate the materials. SARA also provides for greater interaction with public and state agencies and expands the role of the EPA in the evaluation of the health risks associated with contamination. SARA requires early determination of ARARs and the consideration of potential remediation alternatives at the initiation of a RI/FS. Remedial actions taken under CERCLA must comply with ARARs, which generally consist of federal, state, and local regulations. Remedial actions at facilities regulated under CERCLA are selected based on the results of an RI/FS. The RI/FS process is described in the NCP. The RI phase includes specific steps for determining the nature and extent of environmental contamination. Subsequently, the FS is implemented to evaluate alternative remedial actions prior to selection of the most appropriate action for a specific facility.

To respond to changes in the NCP brought about by SARA, the Air Force modified its IRP in November 1986 to improve continuity in the site investigation and remedial planning process for Air Force installations. In July 1987 the President signed Executive Order 12580, delegating responsibility to secretaries of various agencies to conduct site investigations and remedial actions at federal facilities. The order defined relationships between various federal and state agencies and assigned EPA the role of facilitator in resolving conflicts.

Prior to 1988 the Air Force IRP was organized into four phases, described below:

- Phase I, Installation Assessment/Records Search, identified past waste disposal sites at Air Force installations that might pose a hazard to public health or the environment. Sites identified during Phase I could be recommended for no further action, confirmation studies (Phase II), or remedial action (Phase IV).

- Phase II, Confirmation/Quantification, was intended to define and quantify contamination present at sites identified during Phase I. Stage 1 of Phase II consisted of an initial assessment, including environmental sampling, to determine whether contamination was present. Depending on the results of Stage 1, subsequent stages of investigation could be recommended to improve the characterization of site contamination.

- Phase III, Technology-Based Development, included development of new technologies for treating contaminants identified at Air Force installations. The results of Phase II investigations were used to determine the need for Phase III activities.

- Phase IV, Remedial Action, involved development and implementation of plans to remedy contamination at sites.

In 1988, the Air Force replaced the phased approach of the IRP with an approach more closely resembling the RI/FS approach used by EPA. Under this approach, Phase II investigations and Phase IV remedial action planning are conducted in a more parallel fashion to expedite implementation of site cleanups.

1.2 INSTALLATION DESCRIPTION AND ENVIRONMENTAL SETTING

Barter Island radar installation, also known as BAR-M, was the prototype DEW Line station and has been in active use since 1952. The Barter Island DEW Line station is one of many DEW Line stations located across the arctic regions of North America and Greenland. The stations operate and maintain radar systems for the detection of aircraft that may be a threat to national security.

The installation consists of two module trains, a power plant, garages, warehouses, a hangar, a weather building, and radar and communication structures. The general location of Barter Island radar installation is shown on Figure 1-1. An area location map is presented in Figure 1-2, and a site plan is provided as Figure 1-3.

1.2.1 Physical Geography

The Barter Island radar installation is located on an island at 70°08'N, 143°35'W, approximately 75 miles west of the Canadian border on the Arctic Coastal Plain, adjacent to the native village of Kaktovik. The facility is established in 4,353 acres of low lying tundra on the northern border of the ANWR. The maximum elevation on Barter Island is 55 feet above MSL, and drainage is radially away from the high points. The Barter Island station is situated adjacent to the northern coast, on a relatively flat area below a gradual slope. Upslope from the station is a freshwater lake used as a drinking supply for the station and Kaktovik village. Kaktovik is located approximately 1/2 mile east of the station, adjacent to Kaktovik Bay.

1.2.2 Climate (Meteorological Conditions and Air Quality)

Precipitation at Barter Island averages 7 inches per year, which includes 45 inches of snow (CH2M Hill 1981). Average daily minimum and maximum temperatures in summer are 30°F and 46°F, respectively. In winter, these temperatures are -20°F and -6°F, respectively. Temperature extremes for the period of record (1959 to 1974) were -59°F and 78°F (University of Alaska 1978).

In the Arctic Region, strong winds coupled with cold winter temperatures can cause the effective temperature, with the wind chill factor, to reach below -100°F (Selkregg 1975). Prevailing winds are easterly and average near 13 mph with very little annual variation; however, October and November winds are the strongest.

Steady winds of 38 mph have been reported every month of the year, and an extreme steady speed of 81 mph with gusts to 91 mph was reported in January 1974.

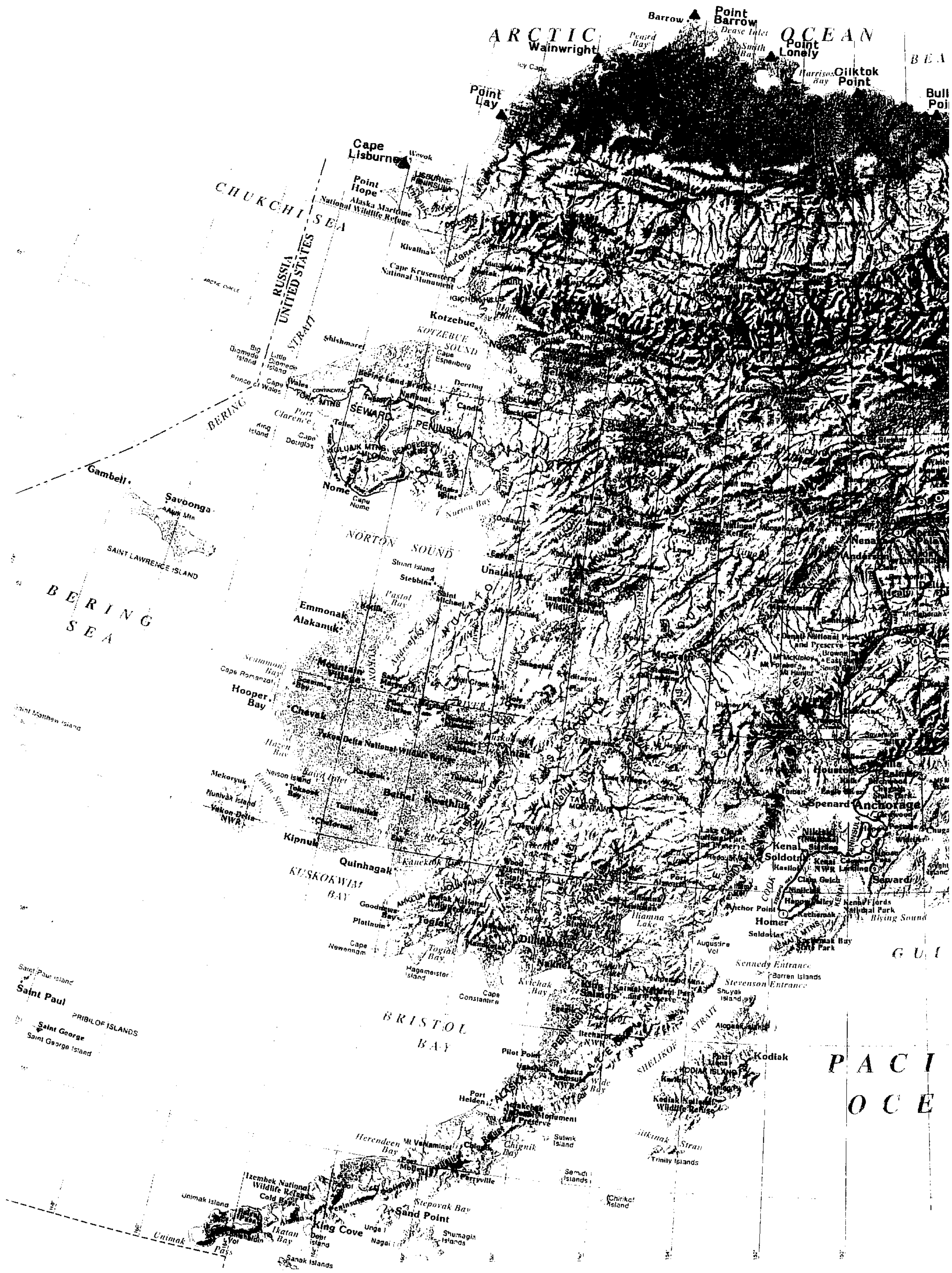
Air quality has not been measured in the Barter Island area. The EPA has classified the area either as being in attainment for all air quality standards, or as not being classifiable (40 CFR, Part 81). Air quality is expected to be good in the Barter Island area due to the absence of any major sources of air pollution. Localized dispersion can be poor during strong temperature inversion conditions, but the persistent strong winds of the area ensure good ventilation and reduce the potential for significant air quality degradation (Hart Crowser 1987).

1.2.3 Geology

This section presents information on the regional and local geology of the Barter Island area.

1.2.3.1 Regional Geology. Geologic units of all the principal time-stratigraphic systems from Precambrian to Quaternary are represented in Alaska. For the last two or three million years, frost climates have prevailed in Alaska and the geomorphic processes have been either

1



ARCTIC OCEAN
Barrow
Point Barrow
Wainwright
Point Lonely
Oliktok Point
Point Lay
Cape Lisburne
Point Hope
CHUKCHI SEA
Kivalina
RUSSIA
UNITED STATES
Kotzebue
KOTZEBUE SOUND
Shishmaref
BERING STRAIT
Cape Espenberg
Big Diomede Island
Little Diomede Island
Prince of Wales
Wales
SEWARD PENINSULA
Port Clarence
Teller
King Island
Cape Douglas
Nome
Cape Nome
Gambell
Savoonga
SAINT LAWRENCE ISLAND
Norton Bay
NORTON SOUND
Stuart Island
Stebbins
Saint Michael
Unalakleet
BERING SEA
Emmonak
Alakanuk
Scammon Bay
Cape Romanzof
Mountain Village
Hooper Bay
Chevak
Saint Matthew Island
Hazen Bay
Yukon Delta National Wildlife Refuge
Mekoryuk
Nunivak Island
Nelson Island
Toksook Bay
Etolin Strait
Bethel
Kwethluk
Kipnuk
Quinhagak
KUSKOKWIM BAY
Goodnews Bay
Platinum
Cape Newenham
Togiak
Togiak Bay
Hagemeister Island
Dillingham
Naknek
Kvichak Bay
Cape Constantine
BRISTOL BAY
Saint Paul Island
Saint Paul
PRIBILOF ISLANDS
Saint George
Saint George Island
Pilot Point
Port Heiden
Herendeen Bay
Mt Veniaminof
Chignik
Chignik Bay
Perryville
Sutwik Island
Semidi Islands
Chirikof Island
Izembek National Wildlife Refuge
Cold Bay
Unimak Island
Unimak Pass
Ikatan Bay
King Cove
Sand Point
Stepovak Bay
Unga I
Nagai I
Shumagin Islands
Sanak Islands
Iliamna Lake
Augustine Vol
Kennedy Entrance
Barren Islands
Stevenson Entrance
Shuyak Island
Afognak Island
SHELIKOF STRAIT
Kodiak
KODIAK ISLAND
Kodiak National Wildlife Refuge
Sitkinak Strait
Trinity Islands
McGrath
Denali National Park and Preserve
Mt McKinley
Anchorage
Spenard
Houston
Tyonek
Kenai
Soldotna
Nikiski
Kasilof
Homer
Seldovia
Anchor Point
Seward
Kenai Fjords National Park
Blying Sound
Wide Bay
PACI
OCE
GU

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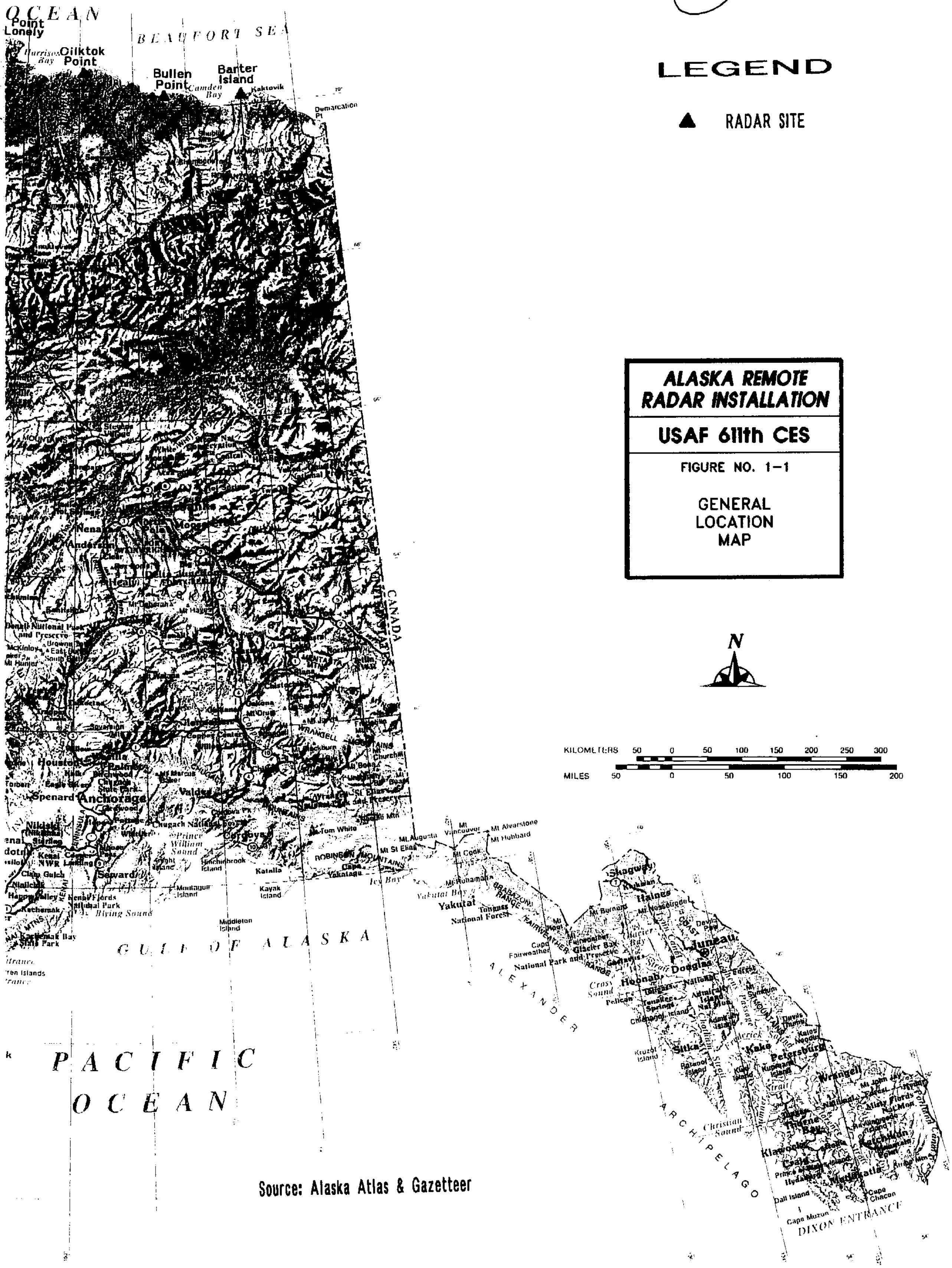

LEGEND

▲ RADAR SITE

ALASKA REMOTE RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 1-1

GENERAL LOCATION MAP

Source: Alaska Atlas & Gazetteer

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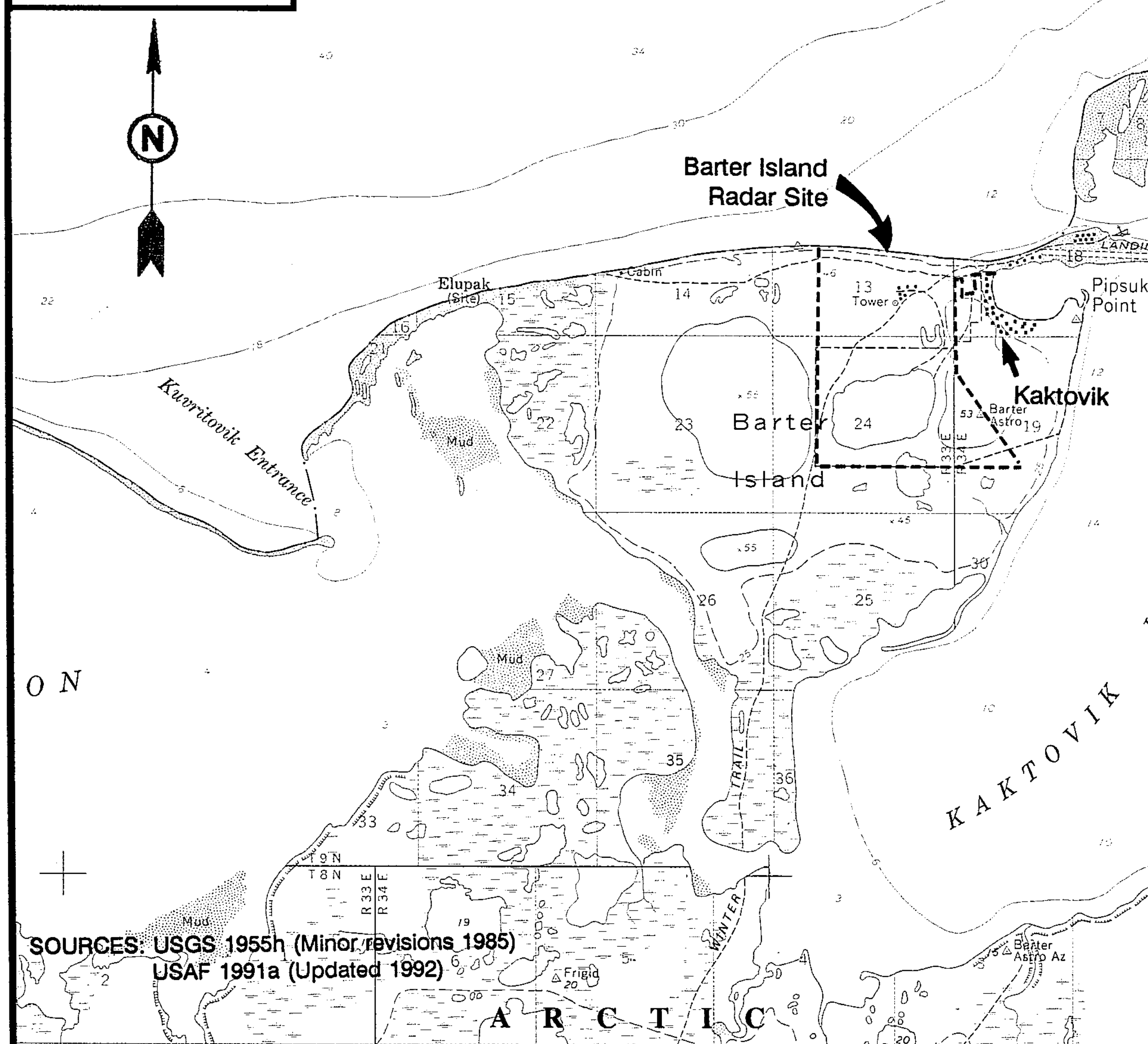

BARTER ISLAND RADAR INSTALLATION

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FIGURE NO. 1–2

AREA LOCATION MAP

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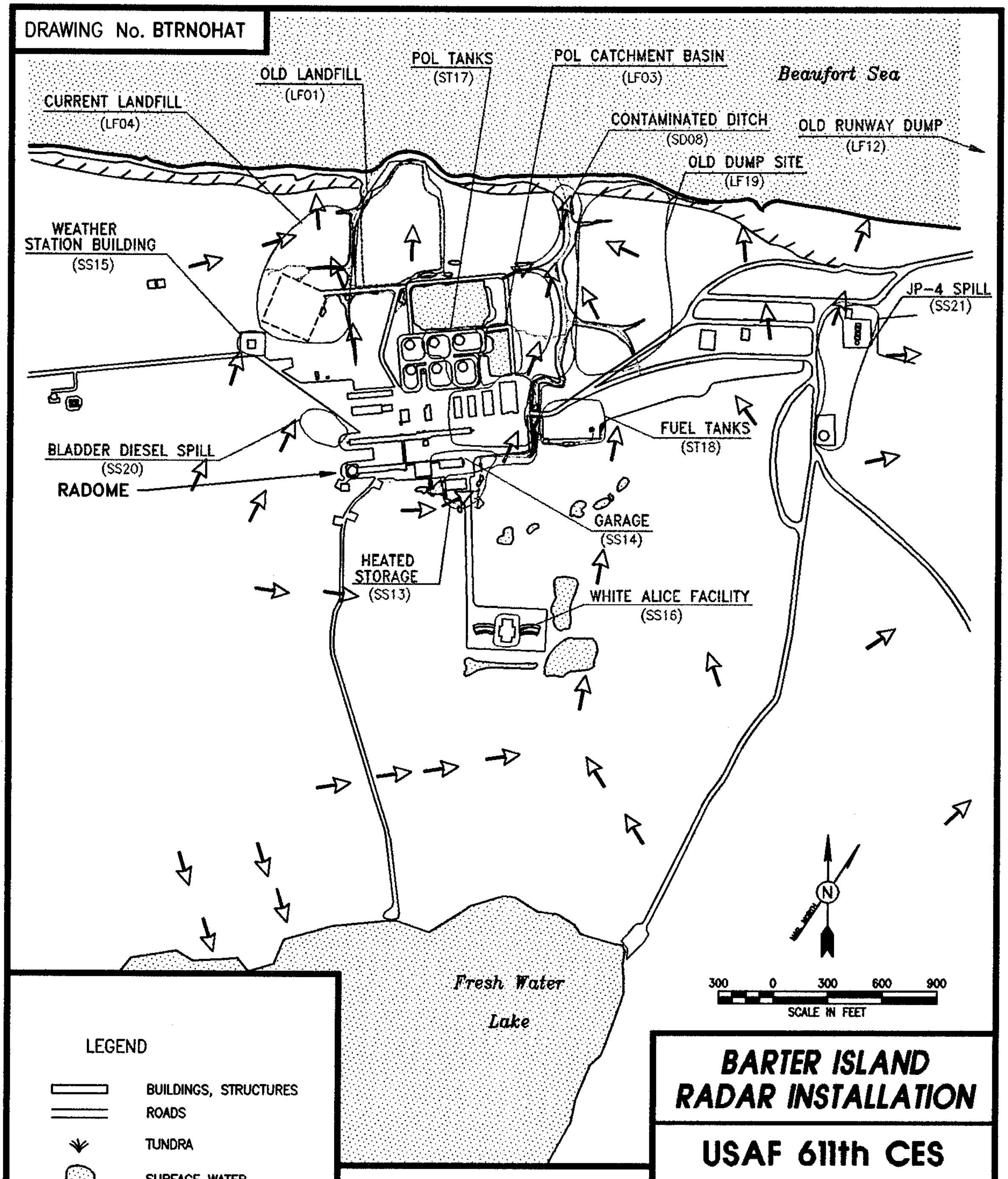

LEGEND

BUILDINGS, STRUCTURES
ROADS
TUNDRA
SURFACE WATER
CULVERT
GRAVEL PAD BOUNDARY
SURFACE DRAINAGE
RI AREAS OF CONCERN

<u>0000</u> CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND NO CONTAMINATION DETECTED
VOC TOTAL VOLATILE ORGANIC COMPOUNDS
DRPH DIESEL RANGE PETROLEUM HYDROCARBONS
HVOC TOTAL HALOGENATED VOLATILE ORGANIC COMPOUNDS

BARTER ISLAND RADAR INSTALLATION

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FIGURE NO. 1-3

INSTALLATION SITE PLAN

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periglacial or glacial (Wahrhaftig 1965). Although glacial activity was extensive, it was by no means all-encompassing. Glaciation is evident in many parts of the state including the Pacific Mountain System, the Arctic Mountains, the Ahklun Mountains, and the southern Seaward Peninsula. Some great expanses, however, had no glacial activity. The principal areas not glaciated include the Intermountain Plateaus, Arctic Foothills, and Arctic Coastal Plain. Many periglacial features such as polygonal ground, sorted circles, pingos, and ice wedges can be observed on the Arctic Coastal Plain. Figure 1-4 depicts the extent of Alaska's glacial areas.

Alaska's generally cold climate regime has produced permafrost, a combination of geologic, hydrologic, and meteorologic characteristics that produces permanently frozen ground. Permafrost occurs in both unconsolidated sediments and bedrock; its distribution includes most of the state, with the notable exception of the Pacific Coastal area. Permafrost is continuous on the Arctic Coastal Plain and has a significant impact on the flow of ground and surface water. The distribution of Alaska's permafrost areas is shown on Figure 1-5. Permafrost is discussed in detail in Section 1.2.4.1.

The very strong geologic processes at work in Alaska have produced a unique environmental setting reflected in the general geology of the Arctic Region (Figure 1-6). A popular theory of the formation of the Arctic Region is that it was once an ocean basin adjacent to the Canadian Shield. Rifting of the Canadian Shield occurred during Mesozoic time, and the Arctic Region drifted southwest forming the Colville Basin to the south and the Arctic Ocean to the north. At the same time, the Brooks Range orogeny began creating a source for the newly-created Colville Basin. Continued uplift of the Brooks Range produced a prograding delta that filled in the Colville Basin.

1.2.3.2 Local Geology. Barter Island, one of a series of barrier islands, is approximately eight square miles in area. The highest elevation on the island is 55 feet above MSL. The island is fairly flat tundra and contains several lakes, a few incised streams, and swampy areas to the south and west.

Barter Island is predominantly covered by a thin tundra mat, beneath which is a layer of sand and loess (wind blown silt) approximately two to three feet thick. Underlying these deposits are lenses and layers of marine and alluvial clay, silt, sand, and sandy gravel of the Meade River Unit of the Gubik Formation. Coastal erosion rates of 7.9 feet per year were reported by Grantz et al. (1980 and 1982). Permafrost in the installation area is up to 1,300 feet thick (Osterkamp and Payne 1981). Due to the permafrost, polygonal surface patterns are abundant.

Natural resources in the area include sand and gravel in the younger sediments and, potentially, coal, oil, and gas in the older deposits. Extensive sand and gravel deposits occur on the beaches west of Barter Island and at the mouth of both the Okpilak and Jago Rivers (NPRA Task Force 1979).

This portion of the Beaufort Sea and Arctic Coastal Plain has an active seismic and deformational history and appears to be the only area on the North Slope that has undergone ground faulting and folding (Grantz et al. 1982). Grantz et al. (1980) reported 26 representative earthquake epicenters in the area, the largest of which occurred on 22 January 1968 and had a magnitude

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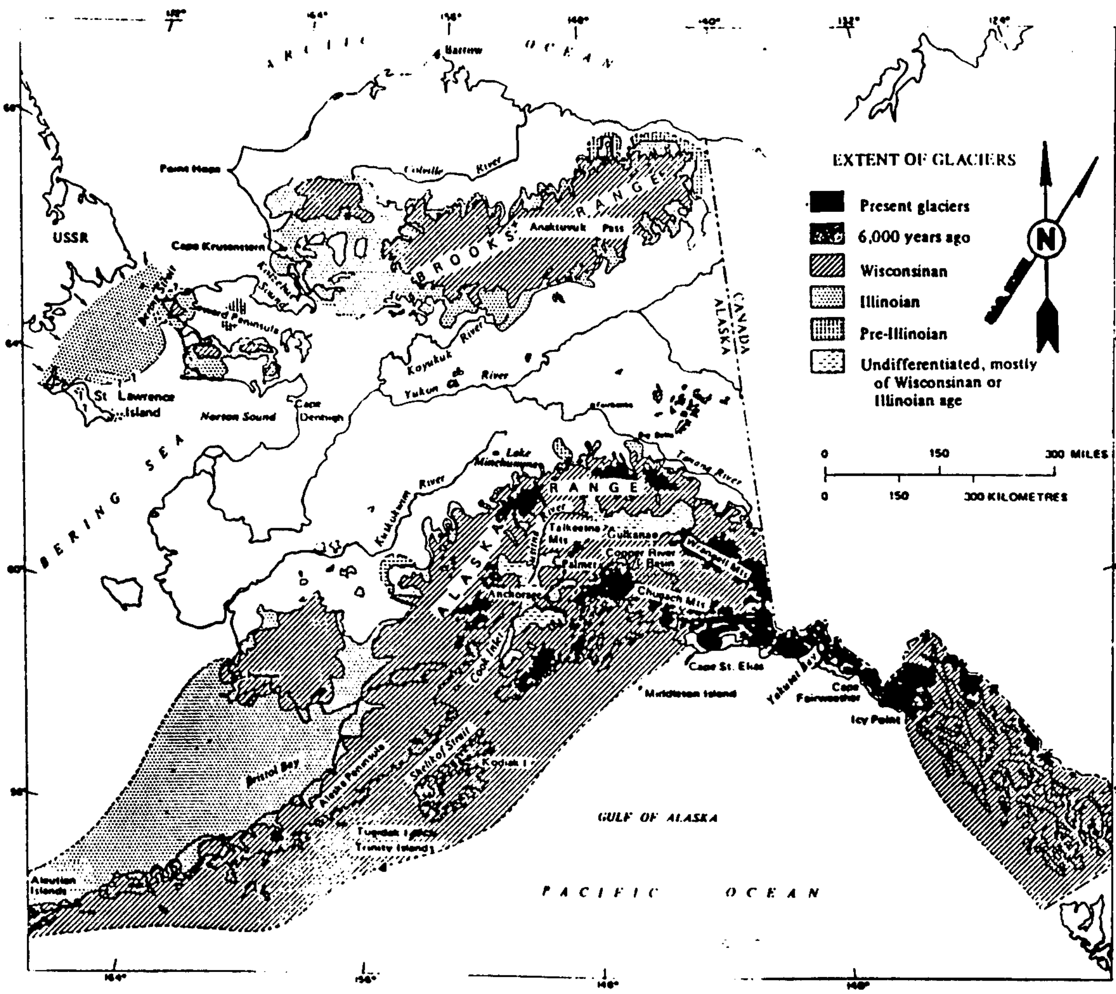

SOURCE: Pewe 1975

ALASKA REMOTE RADAR INSTALLATIONS

USAF 611th CES

FIGURE NO. 1-4

QUATERNARY GLACIATION IN ALASKA

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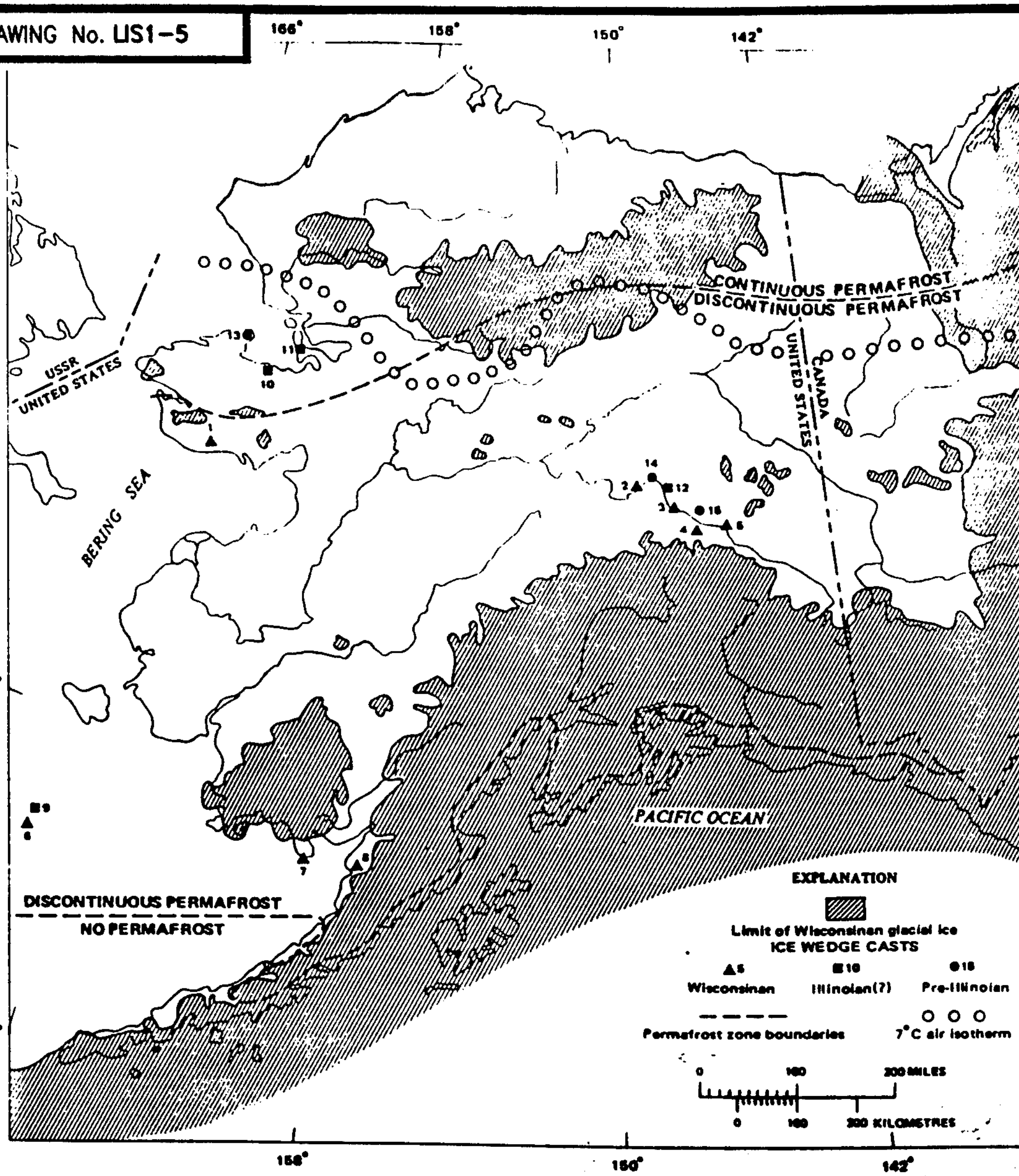

ALASKA REMOTE RADAR INSTALLATIONS

USAF 611th CES

FIGURE NO. 1-5

PERMAFROST MAP

SOURCE: Pewe 1975

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of 5.3 on the Richter Scale. An analysis of sea level changes indicates a probable recurrence interval of a few hundred years for such an earthquake.

In December 1993, an earthquake measuring 5.7 on the Richter Scale was recorded southeast of Barter Island at the base of the Brooks Range.

1.2.4 Hydrology

Ground water/permafrost and surface water are discussed in the following sections.

1.2.4.1 Ground Water/Permafrost. Permafrost has a profound influence on Alaska's ground water resources. Permafrost is defined by the Glossary of Geology (American Geological Institute 1972) as:

- Any soil, subsoil, or other surficial deposit, or even bedrock, occurring in arctic or subarctic regions at a variable depth beneath the earth's surface in which a temperature below freezing has existed continuously for a long time (from two years to thousands of years). This definition is based exclusively on temperature and disregards the texture, degree of compaction, water content, and lithologic character of the material.

Permafrost has a major impact on the relationship between surface water and ground water in cold regions such as Alaska. Although ground water in permafrost regions follows the same geologic and hydrologic principles as in temperate areas, the hydrologic regime is modified in the following ways:

- Permafrost acts as an impermeable barrier to the movement of ground water because pore spaces are ice-filled in the zone of saturation. Recharge and discharge are, therefore, limited to unfrozen channels penetrating the permafrost zone. The unfrozen channels are termed perforating taliks. Permafrost restricts the downward percolation of water and increases runoff, enhancing the creation of lakes and swamps (Feulner et al. 1971).

- Permafrost zones tend to reduce evapotranspiration. The generally low ground temperatures tend to reduce direct evaporation and transpiration (the escape of moisture through plant tissue into the air). Vegetation growth is enhanced near large surface water bodies where permafrost usually occurs at greater depth.

- Permafrost restricts an aquifer's storage capacity and the number of locations from which ground water may be withdrawn. Subpermafrost ground water occurs beneath the permafrost zone and is usually dependable. Suprapermafrost water occurs in the active zone, above the permafrost table, and tends to be seasonal; it freezes during the cold winter months.

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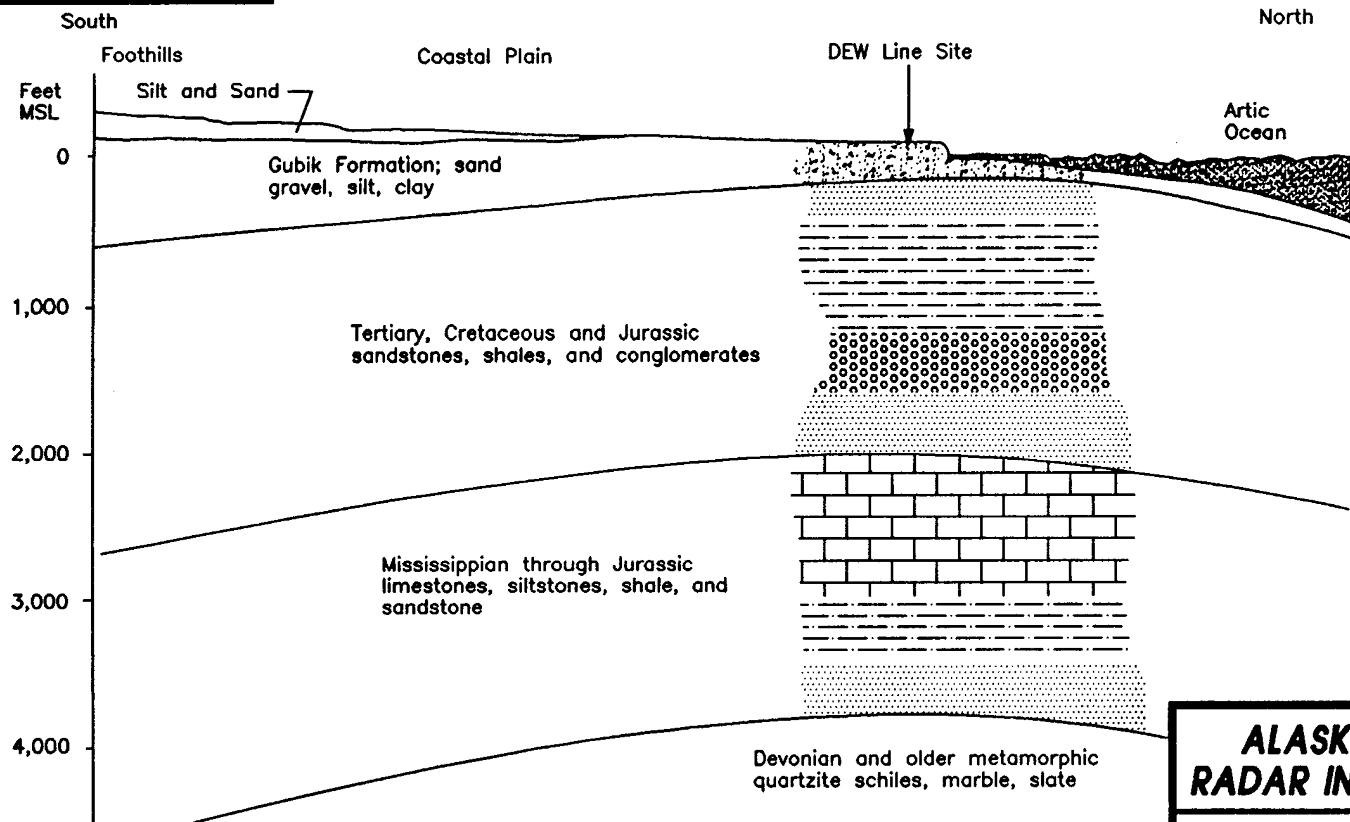

SOURCE: CH2M HILL 1981

Not to Scale

ALASKA REMOTE RADAR INSTALLATIONS

USAF 611th CES

FIGURE NO. 1-6

GENERALIZED NORTH-SOUTH GEOLOGIC CROSS SECTION

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- The ground water temperature varies from 32 to 40.1°F in permafrost regions because of the low ground temperatures (Williams 1970). Water tends to be more viscous in this temperature range and, therefore, moves slower than in temperate regions.

Low ground temperatures create the necessary environment for permafrost to form. The segment above the permafrost table is called the active zone, because it freezes and thaws with seasonal weather changes. The permafrost zone remains frozen year-round. The active zone is significant because suprapermafrost active zone water exists within it.

Ground water has been found in aquifers beneath the continuous permafrost, but little is known of these aquifer systems. Shallow ground water sources are also present in river gravel and in thaw bulbs beneath deep lakes. Active zone water is found during the summer months when this layer thaws, but the layer is relatively thin. The thickness of the active zone at Barter Island is estimated to range from one to six feet.

Surface features may have dramatic impacts on the subsurface distribution of permafrost because they influence heat transfer. Heat flow through surface water is greater than through land. Permafrost may be discontinuous or present at greater depth under and near large bodies of water such as rivers or deep lakes. Smaller bodies of water may affect the configuration of the permafrost surface or the total thickness of the permafrost at any given point. Figure 1-7 is a generalized representation of the relationship of surface features to the underlying permafrost.

1.2.4.2 Surface Water. Small streams drain the several large and small lakes and swampy land occurring on the south, east, and west sides of Barter Island. The largest lake on the island, Fresh Water Lake, is approximately 0.8 miles south of the DEW Line station. This nine-foot deep lake, which freezes to approximately eight feet in winter, is used as a year-round potable water source (NPRA Task Force 1979).

Several small streams cross the Barter Island facility. The drainage is generally to the north. Surface runoff occurs as sheet flow and ephemeral streams, and may drain into larger streams or directly to the ocean. Three drainage ditches, the Contaminated Ditch (SD08) and two that border the Old Landfill (LF01), flow from the station area to the sea. Infiltration to shallow depths may occur during summer months when the active layer of the permafrost thaws. The surface water drainage features in the vicinity of the installation are shown on Figure 1-8.

1.2.5 Industrial Activities

The Barter Island facility was constructed as a main DEW Line station. It consists of two module trains ("A" and "B"), rotating radar, and facilities to provide full logistics support for the rest of its sector. The main section of train "A" houses the electronics equipment work areas and the radar tower, limited personnel quarters, administration offices, a mechanical room with emergency boiler and fuel storage, and a personnel support module with water storage, showers, and toilets. Adjacent to this structure, and connected by corridors, are the power plant and vehicle maintenance buildings. Train "B" is the main living and personnel support area. The dining and

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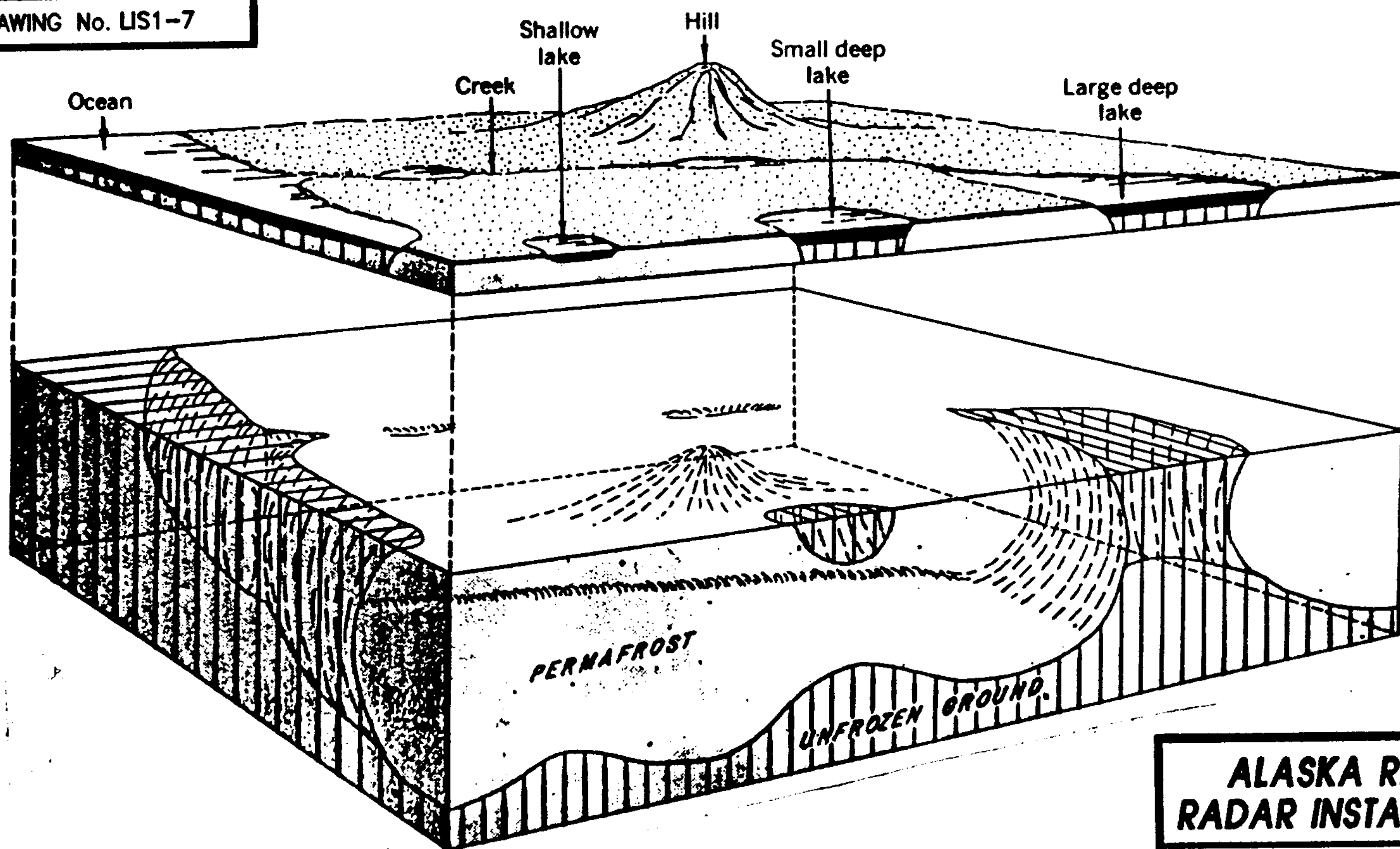
DRAWING No. LIS1-7



SOURCE: Selkregg 1975

ALASKA REMOTE RADAR INSTALLATIONS

USAF 611th CES

FIGURE NO. 1-7

SURFACE FEATURE IMPACTS ON PERMAFROST DISTRIBUTION

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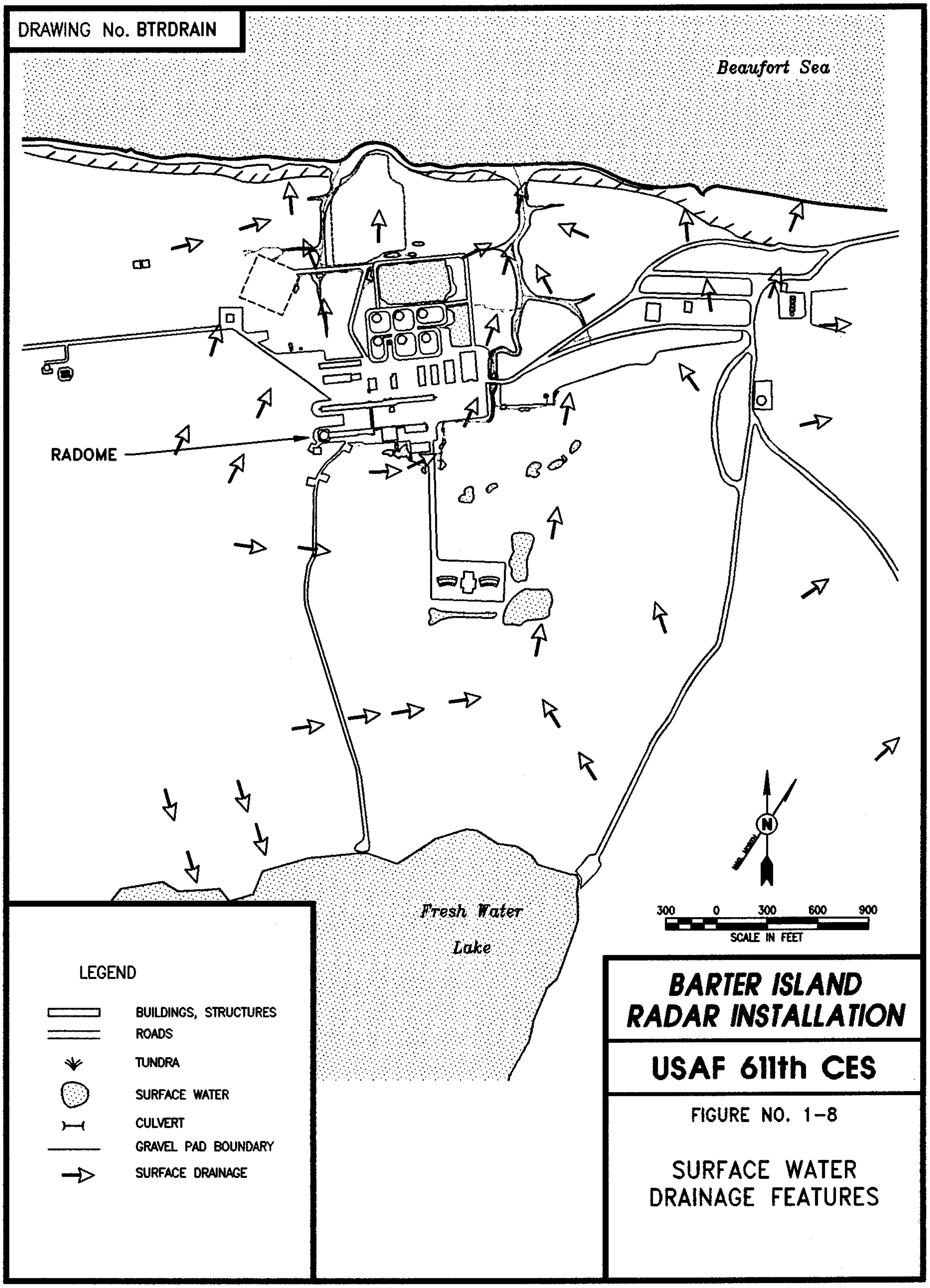
DRAWING No. BTRDRAIN
Beaufort Sea
RADOME
Fresh Water
Lake
300 0 300 600 900
SCALE IN FEET
N
LEGEND
BUILDINGS, STRUCTURES
ROADS
TUNDRA
SURFACE WATER
CULVERT
GRAVEL PAD BOUNDARY
SURFACE DRAINAGE
BARTER ISLAND
RADAR INSTALLATION
USAF 611th CES
FIGURE NO. 1-8
SURFACE WATER
DRAINAGE FEATURES

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recreation areas are located in the center of this module train. Mechanical rooms are distributed throughout the living quarters. The solid waste incinerator is connected by a corridor to module train "B".

The rotating radar is in the radome. The radome, platform, plenum, and stairwell/cable chase are supported by steel columns and trusses. The radome is located on the west end of module train "A". There are also two formerly used communications billboards ("White Alices") and an inactive radio relay building located south of the module trains. Aircraft facilities include a lighted gravel runway and hangar. The runway is 4,820 feet long with a 260-foot overrun on the east end and a 480-foot overrun on the west end.

1.2.6 Biology

This section presents information on the regional fauna and flora of the Barter Island area.

1.2.6.1 Vegetation. There are three major habitat types on Barter Island: beach and spit, tidal salt marsh, and tundra. Beach communities support stands of lyme grass, *Elymus arenarius*; prostrate willows, *Salix* spp.; and other grasses. Salt marsh communities support alkali grass, *Puccinellia phyrganodes*; sedges, *Carex* spp.; and *Stellaria humifusa* grading into sedge-grass dominance (*Carex aquatilis*; tundra grass, *Dupontia fischeri*; polar grass, *Arctagrostis latifolia*; cottongrass, *Eriophorum* spp.; and willows) as the exposure to salt water decreases. Tundra includes wet and moist complexes dominated by cottongrass; sedges, *(C. bigelowii, C. membranacea*); avens, *Dryas* spp.; lousewort, *Pedicularis* spp; and bistort, *Polygonum bistorta*. Lichens (*Thamnolia* spp., *Cetraria* spp., and *Cladina* spp.) are also common (Hart Crowser 1987; NPRA Task Force 1978; Bergman et al. 1977).

1.2.6.2 Fish. Most marine and anadromus fish of the Beaufort Sea are seasonally present in the lagoons and rivers around Barter Island. Arctic char, *Salvelinus alpinus*, is the most numerous fish in the Kaktovik Lagoon area. Other species in the area are fourhorn sculpin, *Myoxocephalus quadricornis*; arctic flounder, *Liopsetta glacialis*; arctic cisco, *Coregonus autumnalis* ; saffron cod, *Eleginus gracilis*; least cisco, *Coregonus sardinella*; arctic grayling, *Thymallus arcticus*; eelpout, *Lycodes* spp.; and rainbow smelt, *Osmerus mordax* (Woodward-Clyde 1993). Freshwater fish are limited by the scarcity of appropriate habitat.

1.2.6.3 Birds. Barter Island provides important habitats for birds, with a total of 108 species reported in the area (Hart Crowser 1987). Permanent residents include rock ptarmigan, *Lagopus mutus*; common raven, *Corvus corax*; snowy owl, *Nyctea scandiaca*; black guillemot, *Cepphus grylle*; and American dipper, *Cinclus mexicanus*. Redpoll, *Carduelis flammea*; ivory gull, *Pagophila eburnea*; willow ptarmigan, *Lagopus lagopus*; and Ross' gull, *Rhodostethia rosea*, may occasionally overwinter. Migratory species traditionally use the area for breeding, molting, and pre-migratory staging. Principal migratory species include snow geese, *Chen caerulescens*; brant, *Branta bernicla*; white-fronted goose, *Anser albifrons*; Canada geese, *Branta canadensis*; whistling swan, *Olor columbianus*; pintail, *Anas acuta*; eiders, *Somateria* spp.; American widgeon, *Anas americana*; scaup, *Aythya marila*; oldsquaw, *Clangula hyemalis*; loons, *Gavia* spp.; jaegers, *Stercorarius* spp.; gulls, *Larus* spp.; sandpipers, *Calidris* spp.; terns, *Sterna* spp.; and phalaropes,

Phalaropus spp. The Lapland longspur, *Calcarius lapponicus*, is the dominant passerine species Hart Crowser 1987; USFWS 1992).

Raptors that regularly use the area include peregrine falcon, *Falco peregrinus*; snowy owl, short-eared owl, *Asio flammeus*; marsh hawk, *Circus cyaneus*; rough-legged hawk, *Buteo lagopus*; and golden eagle, *Aquila chrysaetos* (USFWS 1982).

1.2.6.4 Mammals. Common small mammals on the nearby ANWR coastal plain, and presumably on Barter Island as well, include collared lemmings, *Dicrostonyx groenlandicus*; brown lemming, *Lemmus trimucronatus*; voles, *Microtus* spp.; and ground squirrels, *Spermophilus* spp. Arctic fox, *Alopex lagopus*, range throughout the area (Hart Crowser 1987).

Marine mammals of the Beaufort Sea include bowhead whale, *Balaena mysticetus*; gray whale, *Eschrichtius robustus*; narwhal, *Monodon monoceros*; and bearded seal, *Erignathus barbatus*. Ringed seals, *Phoca hispida*, may use the surrounding lagoons in the summer and fall.

Caribou, *Rangifer tarandus*, from both the Central Arctic and Porcupine herds are seasonally associated with the area south of, and sometimes including, Barter Island. Calving for the Porcupine herd is concentrated in the area south of Camden Bay (southwest of Barter Island), but principal calving grounds shift from year to year. Caribou from the Central Arctic herd occur in the area southwest of Barter Island during the summer dispersal (Hart Crowser 1987).

Three muskox, *Ovibos moschatus*, herds in Alaska move along riparian habitats south of Barter Island. Gray wolves, *Canis lupus*, and brown (or grizzly) bear, *Ursus arctos*, may occasionally be seen in the area, but are considered rare on Barter Island. Polar bear, *Ursus maritimus*, are frequently sighted on Barter Island; they are attracted to the area by whale remains left on the northeast corner of the island.

1.2.6.5 Endangered Species. The peregrine falcon, previously listed as threatened, and the gray whale, previously listed as endangered, have been delisted by the U.S. Fish and Wildlife Service. A records search conducted by the Alaska Natural Heritage Program (1993) indicated that currently protected species potentially occurring in the vicinity of Barter Island include bowhead whale, (endangered) and spectacled eider, *Somateria fischeri* (threatened). Alaska Biological Research (1994) conducted surveys for spectacled and Steller's eiders at Air Force radar installations and concluded that although there is little chance for spectacled or Steller's eiders to nest at Barter Island, casual occurrence was possible.

1.2.7 Demographics

The Barter Island installation consists of 4,353 acres of land on Barter Island. It is located approximately 646 miles north of Anchorage and 389 miles north of Fairbanks. Air travel provides the only year-round access, while travel by waterway provides seasonal access.

The native village of Kaktovik is located approximately one half mile southeast of the main living area at the Barter Island installation. The village of Kaktovik dates back to 1923 when a trading station was established during the height of the fur trade. The community relocated in 1947,

1952, and 1964 to accommodate the establishment and expansion of the Barter Island installation. Approximately seven personnel currently are stationed at the Barter Island facility. Kaktovik has a population of approximately 224 (North Slope Borough 1980).

1.2.7.1 Local Economy. Economic opportunities in Kaktovik are limited because of the isolated nature of this most easterly of the North Slope Borough villages. Jobs are provided by a store, local government administration, a school, a clinic, a local flying service, and construction projects for village facilities. The sale of arts and craft items, particularly baleen baskets and Eskimo clothing, also brings cash income to some individuals.

Subsistence hunting, fishing, and trapping have always been important parts of the culture and economy of Kaktovik. The Barter Island installation is located within the subsistence use area of the village (Hart Crowser 1987). Subsistence resources available in the area include fish, migratory waterfowl, and caribou. Polar bear occasionally are shot near the village. When conditions permit, caribou range onto Barter Island and are hunted. Bowhead whales are beached for butchering between the airfield and the radar installation.

1.2.7.2 Cultural Resources. Six cultural resource sites, including traditional land use and prehistoric sites, are known to exist in the vicinity of Barter Island. The oldest and most substantial site, Qaaktugvik, consists of between 30 and 40 house pits. It probably represents the Thule Tradition (U.S. Fish and Wildlife Service 1982) and was the site of an important trading center in historic times for people traveling along the coast. The original village of Kaktovik was located on this site until 1947 when it was moved to allow construction of an airstrip for the U.S. Navy. In the construction process the site was severely disturbed.

Most of the other cultural resources in the area represent Traditional Land Use sites and are summarized in Table 1-1. These sites have not been evaluated for listing in the National Register of Historic Places.

1.2.7.3 Recreation. The area around the station offers more opportunity for recreation than most of the Arctic Coast. Although access is limited to commercial and chartered air travel, the station lies near the northern edge of the ANWR, where camping, hiking, kayaking, cross-country skiing, snowshoeing, and wildlife viewing take place.

Bingo is a major recreational activity for the native people of Kaktovik. Proceeds provide funding for special celebrations and events. The school district provides educational tapes, infrequent commercial programming on closed-circuit television, and a place for recreational activities (Hart Crowser 1987). A few playground items are available for the children.

1.3 SITE INVENTORY

This section presents information on the IRP sites at the Barter Island radar installation. It includes summaries of previous IRP activities and remedial actions that have been conducted at the installation.

1.3.1 Sites at Barter Island

Fourteen sites at the Barter Island radar installation were investigated during the 1993 RI activities. Five sites were determined to be of concern based on previous IRP sampling data. Additionally, there were nine sites identified for investigation based on previous IRP activities and the 1993 RI activities. The five sites previously sampled are the Old Landfill (LF01), POL Catchment (LF03), Current Landfill (LF04), Contaminated Ditch (SD08) and Weather Station Building (SS15). Previous IRP sampling at these areas determined that contaminants were present. Additional sites were identified based on previous IRP activities and the 1993 RI activities as listed: literature search, pre-survey and reconnaissance, interviews with station personnel, communication with personnel from the ADEC, and information on disposal practices at DEW Line stations. Additional sites include the Old Runway Dump (LF12), the Heated Storage (SS13), Garage (SS14), White Alice Facility (SS16), POL Tanks (ST17), Fuel Tanks (ST18), Old Dump Site (LF19), Bladder Diesel Spill (SS20), and the JP-4 Spill (SS21). Prior to this RI/FS, no sampling had been conducted at these nine sites.

It should be noted that none of the 14 sites is on, or is proposed to be included in, the national priority list (NPL) of Superfund sites.

1.3.2 Previous IRP Activities

An Air Force contractor conducted Phase I Installation Assessment/Records Search activities at the Barter Island radar installation and six other DEW Line stations in 1980 and 1981 (CH2M Hill 1981). Phase I activities included a detailed review of pertinent installation records from both government and civilian contractors, contacts with various government and private agencies for documents relevant to the program, and onsite visits during July and August 1981. The onsite visits included interviews with key station employees, ground tours of station facilities, and plane overflights to identify past disposal and possible contaminated areas.

Stages 1 and 2 of the Phase II Confirmation/Quantification activities were conducted in 1986 (Dames and Moore 1986, 1987). Phase II, Stage 1 activities involved field investigations of specific sites that were identified in the Phase I Installation Assessment/Records Search activities. Soil grab samples were collected at two sites at the Barter Island installation, and surface water samples were collected at three sites during the field investigation.

A Technical Operations Plan for the Phase II, Stage 2 work was prepared in August 1986 (Dames and Moore 1987). Phase II, Stage 2 activities involved field investigation of five sites, including additional soil and surface water sampling based on findings from the Phase II, Stage 1 field investigation. Onsite observations and analytical results were recorded in the Phase II, Stage 2 Draft Report.

In March 1986, an Environmental Assessment was prepared for a proposed prototype Short Range Radar station at the Barter Island DEW Line station and concluded that sociocultural and air quality impacts would be insignificant (Metcalf and Eddy 1986).

TABLE 1-1. KNOWN CULTURAL RESOURCE SITES IN THE VICINITY OF BARTER ISLAND RADAR INSTALLATION[a]

SITE NAME	TLUI #[b] / AHRS #	DESCRIPTION	LOCATION
Qaaktugvik (Kaktovik 1st location)	20 / XBRL-002	Prehistoric village site. In 1930 consisted of 30 to 40 house sites; disturbed by construction of airport and landing strip; cultural material still present on surface.	About one mile east of the Barter Island installation, in the vicinity of the airport.
Qaaktugvik (Kaktovik 2nd location)	21 / --	Village of Kaktovik moved here in 1947. Remains include cemetery, ice cellar, scattered wood fragments.	On DEW Line property near juncture of spit and main part of island.
Qaaktugvik (Kaktovik present location)	22 / --	Village moved to present location in 1964.	Village borders southern DEW Line boundary.
Pipsuk Point	23 / --	Pipsuk's grave, marked with wooden cross.	About one mile east of the Barter Island installation, south and across lagoon from airport.
Iglukpaluk	18 / XBRL-004	Tom Gordon's trading post, est. 1923. Ice cellar, house foundation; currently summer fishing camp.	1.7 miles west of the Barter Island installation on the island's north shore.
Tikluk	19 / XBRL-006	Andrew Akootchook's family home; house ruins present.	2.5 miles southwest of the Barter Island installation.

a Data from Hall (1982); Jacobson and Wentworth (1982).
b TLUI = Traditional Land Use Inventory.
AHRS = Alaska Heritage Resource Survey.

Source: Hart Crowser 1987

By 1988, the Air Force had replaced the phased approach with an approach more similar to the RI/FS activities of EPA. RI/FS Stage 3 activities and a Final Work Plan were completed for the Barter Island installation in June 1988 (Woodward-Clyde 1988). The Stage 3 Final Work Plan, which organized the work in terms of five sites, called for subsurface soil investigations, surface water and sediment sampling, possible removal actions, hydrologic assessment, a demographic survey, an endangerment assessment (health risk assessment), and an FS for the remedial alternatives. The Stage 3 Final Report of September 1990 summarized the results of the RI and supported a "no further action" decision (Woodward-Clyde 1990).

The Air Force's IRP Decision Document for Barter Island of October 1990 concluded that no further action was needed at the five RI/FS sites. However, correspondence from ADEC personnel to Air Force personnel in November 1991 disagreed with the "no further action" conclusion, and stated that further investigation was needed and corrective action appeared necessary because of improper waste disposal practices and other issues.

An environmental site assessment was conducted at the Weather Station Building in 1992 (Shannon and Wilson 1992). The University of Alaska, Fairbanks had plans to modify the existing building into a remote observation station and balloon launching site.

1.3.3 Previous Remedial Actions

The Air Force in 1992 conducted interim remedial actions that consisted of a general cleanup of exposed wastes at the Old Landfill (LF01), Current Landfill (LF04), and Contaminated Ditch (SD08). Cleanup actions at the Old Landfill included compaction, grading, removal of drums, and the construction of a seawall that now prevents erosion of the landfill by coastal wave action. Cleanup actions at the Current Landfill (LF04) consisted of a general cleanup of debris from the site. For the Contaminated Ditch, cleanup actions included removing drums and exposed debris. In addition, the floor drains of the Heated Storage Building (SS13) and Garage (SS14) were sealed in July 1993 by the Air Force to prevent the possibility of future release of contaminants. The drains in these buildings previously discharged directly to the tundra beneath each structure.

2.0 PROJECT ACTIVITIES

This section of the report describes the project objectives and scope, the RI field program and methodology, the analytical programs, background sampling, and analytical results. In addition, data evaluation, risk estimate methodologies, potential migration pathways, and receptors are presented.

2.1 PROJECT OBJECTIVES AND SCOPE

The objectives of the Barter Island DEW Line radar installation RI/FS are to confirm the presence or absence of chemical contamination in the environment at the installation; define the extent and magnitude of confirmed chemical releases; gather adequate data to determine the magnitude of potential risks to human health and the environment; and gather adequate data to identify and select the appropriate remedial actions for sites where apparent risks exceed acceptable limits or contamination exceeds regulatory guidelines. The project objectives include the following goals:

- Define the horizontal and vertical extent of soil contamination and the range of contaminant concentration;

- Determine the physical and chemical properties of soil contaminants to describe contaminant toxicity and mobility;

- Define the extent of surface and active zone water contamination and the range of contaminant concentrations;

- Describe real and potential surface and subsurface contaminant migration pathways in terms of movement of dissolved and suspended contaminants through the active zone above permafrost, and movement of dissolved and suspended contaminants in surface water;

- Generate adequate valid data to support development of a baseline risk assessment that quantifies, to the extent possible, potential risks to human health and the environment posed by COCs at the Barter Island DEW Line installation studied under this RI; and

- Select the most feasible remedy, cleanup action, to reduce risks at sites where risks exceed acceptable limits.

2.2 RI FIELD ACTIVITIES

This section presents a summary of the field activities conducted during the RI, the organization of the RI field team, and the chronology of field work.

2.2.1 RI Field Program

The RI field program at the Barter Island radar installation was carried out in accordance with the RI/FS Work Plan, the SAP, and the Health and Safety Plan (U.S. Air Force 1993a,b,c). These RI/FS planning documents were developed as specified in the Delivery Order No. 22 Statement of Work (Appendix C) and IRP Handbook (U.S. Air Force 1991a).

The scope of this field investigation was described in detail in the Field Sampling Plan (U.S. Air Force 1993b). The field activities included the following:

- Collecting and analyzing surface and subsurface soil samples from sites with potential or confirmed soil contamination. These soil samples were described and analyzed for petroleum and other chemical residues. Samples were collected using hand tools.

- Collecting and analyzing samples of surface water from potentially affected streams, surface water features such as lakes or ponds, and any apparent leachate discharge points.

- Collecting and analyzing background samples to characterize natural background conditions.

- Measuring relative surface elevations of sampling points and stream channels to determine surface slopes and stream gradients.

- Collecting samples of potential chemical residues and waste materials at sites where such materials were suspected and had not yet been characterized.

- Conducting real-time air monitoring using portable field instruments.

- Measuring surface distances and approximate elevations to locate sampling points relative to fixed reference points.

The RI activities described above were carried out in three phases as follows:

- Installation Pre-survey. The pre-survey was conducted by a small group of contractor employees (four total) accompanied by Air Force representatives. The purpose of the pre-survey was to confirm the location of areas of environmental concern at the installation. Pre-survey activities were limited to visual inspection of the sites, surface distance measurements, site photography, and confirmation of the location of structures and sites as shown on installation plan maps. The information gathered from the pre-survey was combined with existing documentation to support development of the RI/FS scoping documents. The pre-survey was completed at the Barter Island installation on 11 May 1993 by an Air Force contractor.

- Installation Reconnaissance. The installation reconnaissance was conducted by a group of contractor employees on 28 June 1993. The purpose of the reconnaissance was to identify sampling locations for investigation during the RI. The contractor staff made detailed observations of potentially contaminated areas and performed limited intrusive activities (e.g., digging shallow holes with a shovel to determine the apparent depth of contamination at areas of soil staining). Data gathered during the installation reconnaissance provided the basis for determining the sites to be sampled, the approximate number of samples and their locations, analyses for each sample, and equipment and supply needs for the RI.

- Remedial Investigation/Field Activities. The RI field activities were conducted from mid-August through early September of 1993. The RI was conducted in conjunction with RIs at seven other radar installations located throughout northern Alaska. Fifteen contractor employees were stationed in Alaska for the duration of the RI. Intrusive sampling activities at the Barter Island radar installation included collection of surface and subsurface soil samples with hand tools (e.g., shovels, scoops, bucket augers) and collection of surface water, bottom sediment, and seep samples from potential chemical discharge areas. The RI activities also included operation of temporary northern Alaska (Barrow, Alaska) laboratory facilities operated by a subcontractor.

2.2.2 Field Team Organization and Subcontractors

The organization of the RI field team, the responsibilities of the RI team members, and subcontractors used during RI activities are presented in Figure 2-1 (Note: all Barter Island sampling was conducted by the A RI Field Sampling Team). The AFCEE restoration team chiefs that managed and conducted oversight of the RI field activities included Mr. Marty Faile, Mr. Mike McGhee, and Mr. Samer Karmi.

2.2.3 Chronology of Field Work

The RI field work at the Barter Island radar installation conducted during summer 1993 was accomplished in the following chronological order:

11 May	Conducted pre-survey
29 June	Conducted reconnaissance
09 August	Stockpiled RI sampling supplies at Barter Island radar installation.
10 August	Conducted pre-sampling level survey and partially staked sampling locations at SD08, SS13, and SS14.
11 August	Conducted pre-sampling survey and partially staked sampling locations at LF01, LF03, LF04, LF12, SS15, and background.

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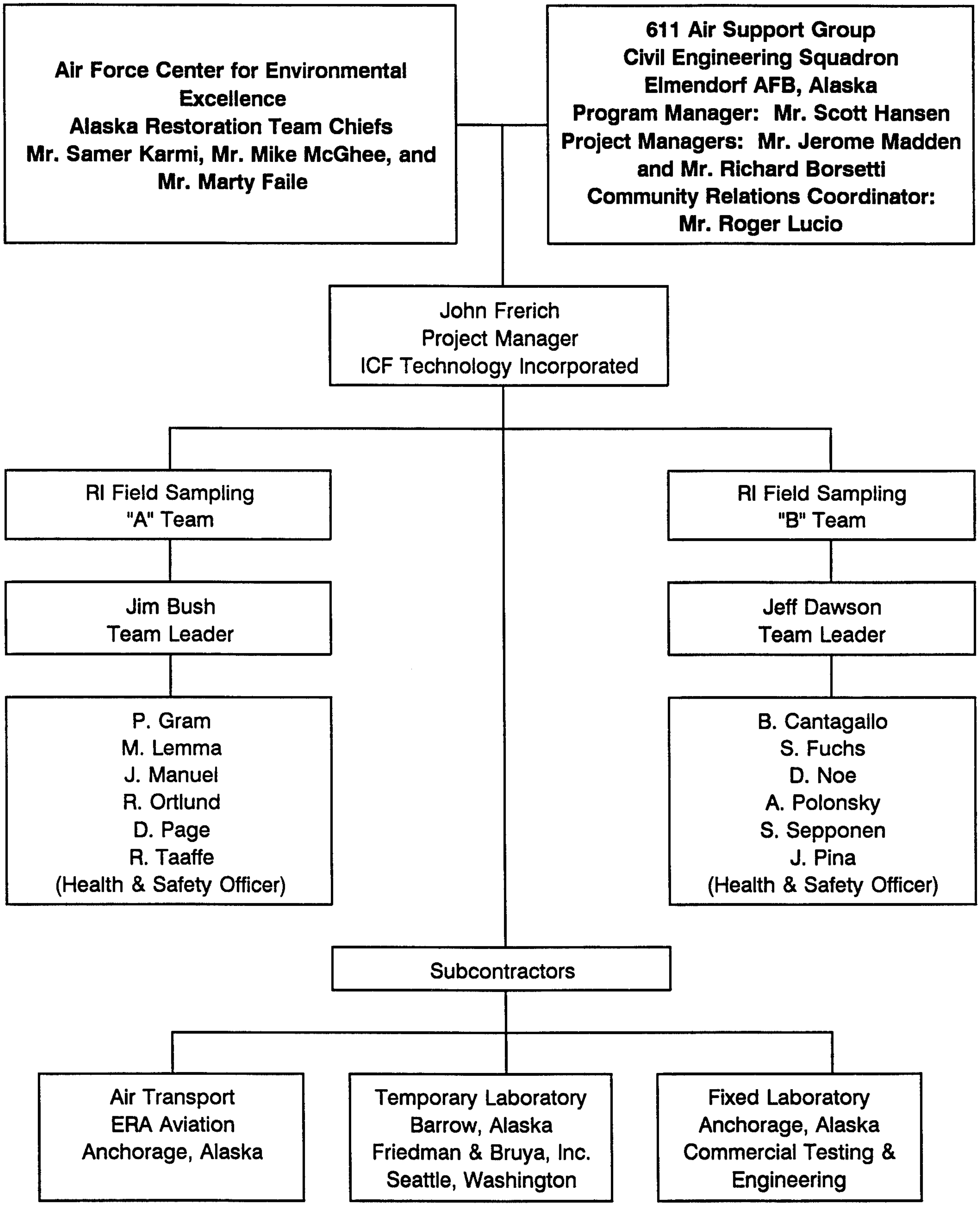
FIGURE 2-1. FIELD TEAM ORGANIZATION



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12 August	Staked sampling locations at LF12 and SS14.
16 August	Collected five soil and four water samples at SD08, five soil samples at SS15, and four QA/QC samples.
17 August	Staked five sample locations at SD08, LF19, SS20, and SS21. Augured nine screening holes at SD08. Collected five soil and two water samples for background, eight soil and three water samples at SD08, and five QA/QC samples.
18 August	Collected ten soil and thee water samples at LF03, two soil samples at SD08, seven soil and two water samples at SS13, and four QA/QC samples.
20 August	Staked four sample locations at SS16. Collected three soil and four water samples at LF01, three soil and two water samples at LF04, five soil samples at ST17, ten soil and one water sample at ST18, and four QA/QC samples.
21 August	Collected one soil sample at LF02, one soil sample at LF04, one water sample and five soil samples at SS14, six soil samples at SS16, six soil samples and one water sample at LF19, five soil and two water samples at SS20, three soil samples at SS21, and eight QA/QC samples.
22 August	Collected three soil samples at LF12.
01 September	Collected four water samples at LF01, two soil samples at LF03, two water samples at LF04, three soil samples at SS15, five soil samples at SS16, two soil samples at SS21, and two QA/QC samples.
02 September	Collected five soil samples at SD08, three soil samples at SS13, three soil samples at SS14, four soil samples at LF19, and four QA/QC samples.
03 September	Collected one background soil sample, one water and two soil samples at LF04, two soil samples at ST18, one waste water sample, and one QA/QC sample.

2.3 RI SAMPLING AND ANALYSES

A summary of the RI sampling and analysis activities conducted during this investigation is presented in this section. Included are descriptions of the number of samples collected by media, QA/QC samples collected, background sampling and analyses, analytical programs,

chronology of laboratory analyses, laboratory QA/QC programs, and data validation and reporting.

2.3.1 Sampling Procedures

Contractor personnel collected samples from various media at the Barter Island radar installation using numerous sample collection methods and procedures. The collection methods were determined at the time of collection, based on sample location and prevailing environmental conditions. Media sampled during the RI included surface and subsurface soils, surface water, and sediment. These media were extracted generally from man-emplaced fill, gravel pads, and scraped areas; and natural tundra soils/sediments and surface water bodies. All sampling tools or other devices used during sampling were decontaminated before use. Standard procedures, developed by the contractor for sampling methodologies used during the RI are presented in Appendix D of the RI/FS SAP (U.S. Air Force 1993b). Sample collection logs for all samples collected during RI activities at the Barter Island installation are presented in Appendix D. The logs provide detailed sample information such as media, location, depth, and analyses requested. Completed chain-of-custody forms for all samples collected during the RI at the Barter Island installation are presented in Appendix E.

2.3.2 Summary of RI Sampling

Contractor personnel collected 190 samples from various media at the Barter Island radar installation. Eight samples were collected to determine organic and inorganic background concentrations in soil/sediment and surface water. Thirty-three samples were collected for QA/QC. QA/QC samples included duplicates, replicates, equipment rinsate blanks, trip blanks, and ambient condition blanks. One-hundred and forty-nine samples were collected to determine the nature and extent of contamination at the 14 sites at Barter Island. Table 2-1 presents a summary of RI sampling conducted at Barter Island.

TABLE 2-1. SUMMARY OF BARTER ISLAND REMEDIAL INVESTIGATION FIELD SAMPLING ACTIVITIES

ACTIVITY	TOTAL
Water Samples Collected for Lab Analyses (includes QA/QC)	51 samples
Soil/sediment Samples Collected for Lab Analyses (including QA/QC)	138 samples
Drums of Investigation Derived Waste Generated (1 drum water)	1 sample
TOTAL WATER AND SOIL SAMPLES FOR LAB ANALYSES	190 samples

2.3.2.1 Field QA/QC Samples. The field QA/QC program consisted of QA/QC samples, QC checks, and limits for field procedures.

QA/QC Samples. QA/QC samples collected during this investigation included duplicate water samples, replicate soil/sediment samples, trip blanks, ambient condition blanks, and equipment rinsate blanks.

During RI sampling activities at the Barter Island installation, QA/QC samples collected included the following: 2 duplicate water samples, 13 replicate soil/sediment samples, 5 trip blanks, 3 ambient condition blanks, and 9 equipment rinsate blanks. In addition, one investigation derived waste sample was collected. Table 2-2 summarizes all samples collected and analyzed during RI activities at the Barter Island installation, including the QA/QC samples.

In addition to the above QA/QC samples, extra volumes of selected samples were collected and submitted for internal laboratory QA/QC (matrix spike and matrix spike duplicates). Extra sample volumes were submitted at a minimum of 1 per 10 samples. Extra volumes submitted included triple volume for organic water analyses and double volume for inorganic water analyses.

2.3.2.2 Background Sampling and Analyses. Eight background samples were collected from three upgradient areas during field activities at the Barter Island radar installation to establish background concentrations for naturally occurring organic compounds. In order to obtain a representative range of inorganic (metal) concentrations in soil/sediments and surface waters of the North Slope, 44 samples (29 soil/sediment and 15 water) from seven North Slope radar installations were collected. The seven installations include Barter Island, Bullen Point, Oliktok Point, Point Lonely, Point Barrow, Point Lay, and Wainwright. Approximately five soil/sediment and two surface water background samples were collected from each of these installations to determine the background concentrations of inorganic analytes across similar coastal arctic environments of the North Slope.

Nine background samples were collected from tundra and pond areas during the RI at Barter Island. These consisted of four soil, three sediment, and two surface water samples.

Four background soil samples were analyzed for DRPH, GRPH, BTEX, halogenated volatile organic compounds (HVOCs), pesticides, and PCBs. In addition, one sample was analyzed for VOCs, SVOCs, total metals, and total organic carbon (TOC).

Three background sediment samples were analyzed for DRPH, GRPH, BTEX, and HVOCs. In addition, two samples were analyzed for VOCs, pesticides, and PCBs. One sample was analyzed for SVOCs, total metals, and TOC.

Two background surface water samples were analyzed for DRPH, GRPH, BTEX, HVOCs, SVOCs, PCBs, pesticides, TOC, total suspended solids (TSS), total dissolved solids (TDS), and total and dissolved metals.

Data Summary. Background sample locations at Barter Island are illustrated in Figure 2-2. The data summary table (Table 2-3) presents analytical results for all background samples collected

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TABLE 2-2. SUMMARY OF SAMPLING AND ANALYSES CONDUCT

ANALYSES	HVOC*	VOC 8010	BTEX*	VOC 8260	SVOC	Metals[b]	TPH-Diesel[b] Range 3510/3550	T
ANALYTICAL METHOD	SW8010M	SW8010	SW8020	SW8260	SW8270	SW3050 (Soil) 3005 (Water)/6010	Diesel 8100M	G
BARTER ISLAND (BAR-M)								
Background	1 Soil	5 Soil 2 Water	6 Soil 2 Water	3 Soil 2 Water	2 Soil 2 Water	2 Soil 2 Water (Total) 2 Water (Dissolved)	7 Soil 2 Water	
Landfill (LF01)	3 Soil 4 Water	NA	3 Soil 4 Water	2 Soil 2 Water	1 Soil 2 Water	2 Soil 2 Water (Total) 2 Water (Dissolved)	4 Soil 8 Water	
POL Catchment (LF03)	NA	7 Soil 1 Water	13 Soil 3 Water	3 Soil 2 Water	3 Soil 2 Water	NA	15 Soil 3 Water	
Current Landfill (LF04)	6 Soil 3 Water	NA	6 Soil 3 Water	4 Soil 3 Water	2 Water	2 Soil 2 Water (Total) 2 Water (Dissolved)	7 Soil 6 Water	
Contaminated Ditch (SD08)	NA	5 Soil	17 Soil 4 Water	2 Soil 2 Water	1 Soil 2 Water	2 Soil 2 Water (Total) 2 Water (Dissolved)	17 Soil 4 Water	
Old Runway Dump (LF12)	3 Soil	NA	3 Soil	1 Soil	1 Soil	1 Soil	3 Soil	
Heated Storage (SS13)	NA	9 Soil 3 Water	13 Soil 5 Water	5 Soil 2 Water	2 Soil 2 Water	2 Soil 2 Water (Total) 2 Water (Dissolved)	14 Soil 5 Water	
Garage (SS14)	5 Soil 1 Water	NA	8 Soil 1 Water	5 Soil	2 Soil 1 Water	2 Soil 1 Water (Total) 1 Water (Dissolved)	9 Soil 1 Water	
Weather Building (SS15)	NA	NA	8 Soil	1 Soil	NA	NA	8 Soil	
White Alice Facility (SS16)	NA	NA	NA	NA	NA	NA	4 Soil	
POL Tanks (ST17)	NA	NA	4 Soil	1 Soil	1 Soil	NA	4 Soil	
Fuel Tanks (ST18)	NA	NA	11 Soil 1 Water	3 Soil 1 Water	3 Soil 1 Water	NA	12 Soil	
Old Dump Site (LF19)	10 Soil	NA	10 Soil 1 Water	2 Soil 1 Water	2 Soil 1 Water	2 Soil 1 Water (Total) 1 Water (Dissolved)	10 Soil	
Bladder Diesel Spill (SS20)	NA	NA	5 Soil 2 Water	3 Soil 1 Water	3 Soil 1 Water	3 Soil	5 Soil 2 Water	
JP-4 Spill (SS21)	5 Soil	NA	5 Soil	1 Soil	1 Soil	NA	5 Soil	
Total Field Analyses	33 Soil 8 Water	26 Soil 6 Water	112 Soil 26 Water	36 Soil 16 Water	22 Soil 16 Water	18 Soil 12 Water (Total) 12 Water (Dissolved)	124 Soil 31 Water	

NA Not analyzed.
* These analyses were completed on a quick turnaround basis.
a The number of soil sample includes sediment samples collected from surface water features.
b Some of these analysis were completed on a 24-hour turnaround at a temporary fixed laboratory at Barrow

(2)

S CONDUCTED FOR BARTER ISLAND REMEDIAL INVESTIGATIONS[a]

TPH-Diesel[b] Range 3510/3550	TPH - Gasoline[b] Range	TPH Residual Range[a]	PCB[a]	Pesticides[a]	TDS	TSS	TOC	TCLP	TOTAL SAMPLES
Diesel 8100M	Gas 5030/8015M	Diesel 8100M	SW8080/8080M	SW8080/8080M	E160.1	E160.2	SW9060	SW1311	
7 Soil 2 Water	7 Soil 2 Water	1 Soil	5 Soil 2 Water	5 Soil 2 Water	2 Water	2 Water	2 Soil 2 Water	NA	6 Soil 2 Water
4 Soil 8 Water	3 Soil 4 Water	4 Soil 8 Water	4 Soil 4 Water	NA	2 Water	2 Water	1 Soil 2 Water	NA	4 Soil 8 Water
15 Soil 3 Water	13 Soil 3 Water	3 Soil	NA	NA	2 Water	2 Water	1 Soil 2 Water	NA	13 Soil 3 Water
7 Soil 6 Water	7 Soil 4 Water	6 Soil 5 Water	4 Soil 2 Water	NA	2 Water	2 Water	2 Soil 2 Water	NA	6 Soil 5 Water
17 Soil 4 Water	17 Soil 4 Water	5 Soil	NA	1 Soil	2 Water	2 Water	2 Soil 2 Water	NA	17 Soil 4 Water
3 Soil	3 Soil	3 Soil	3 Soil	1 Soil	NA	NA	1 Soil	NA	3 Soil
14 Soil 5 Water	14 Soil 5 Water	3 Soil	7 Soil	NA	NA	NA	NA	NA	13 Soil 5 Water
9 Soil 1 Water	9 Soil 1 Water	8 Soil 1 Water	4 Soil	1 Soil 1 Water	NA	NA	NA	NA	8 Soil 1 Water
8 Soil	8 Soil	3 Soil	NA	NA	NA	NA	NA	NA	8 Soil
4 Soil	NA	4 Soil	11 Soil	NA	NA	NA	NA	NA	11 Soil
4 Soil	4 Soil	4 Soil	NA	NA	NA	NA	NA	NA	4 Soil
12 Soil	11 Soil 1 Water	12 Soil	NA	NA	1 Water	1 Water	2 Soil 1 Water	NA	12 Soil 1 Water
10 Soil	10 Soil 1 Water	10 Soil	5 Soil	2 Soil	1 Water	1 Water	1 Soil 1 Water	NA	10 Soil 1 Water
5 Soil 2 Water	5 Soil 2 Water	5 Soil 2 Water	NA	NA	1 Water	1 Water	3 Soil 1 Water	NA	5 Soil 2 Water
5 Soil	5 Soil	5 Soil	NA	1 Soil	NA	NA	1 Soil	NA	5 Soil
124 Soil 31 Water	116 Soil 27 Water	76 Soil 16 Water	43 Soil 8 Water	11 Soil 3 Water	13 Water	13 Water	16 Soil 13 Water		125 Soil 32 Water

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atory at Barrow, Alaska.

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TABLE 2-2. SUMMARY OF SAMPLING AND ANALYSES FOR BART

ANALYSES	HVOC*	VOC 8010	BTEX*	VOC 8260	SVOC	Metals[b]	TPH-Diesel[b] Range 3510/3550	T
ANALYTICAL METHOD	SW8010M	SW8010	SW8020	SW8260	SW8270	SW3050 (Soil) 3005 (Water)/6010	Diesel 8100M	G
QA/QC SAMPLES								
Trip Blanks	2 Water	2 Water	4 Water	4 Water	NA	NA	NA	
Equipment Blanks	5 Water	2 Water	9 Water	8 Water	6 Water	6 Water (Total) 2 Water (Dissolved)	10 Water	
Ambient Condition Blanks	2 Water	1 Water	3 Water	2 Water	NA	NA	NA	
Field Replicates	3 Soil	3 Soil	11 Soil	4 Soil	4 Soil	3 Soil	12 Soil	
Field Duplicates	NA	NA	2 Water	1 Water	1 Water	1 Water (Total) 1 Water (Dissolved)	2 Water	
Total Site Analyses	36 Soil 17 Water	29 Soil 11 Water	123 Soil 44 Water	40 Soil 31 Water	26 Soil 23 Water	21 Soil 19 Water (Total) 15 Water (Dissolved)	136 Soil 43 Water	

NA Not analyzed.
* These analyses were completed on a quick turnaround basis.
a The number of soil sample includes sediment samples collected from surface water features.
b Some of these analysis were completed on a 24-hour turnaround at a temporary fixed laboratory at Barrow

(2)

'OR BARTER ISLAND REMEDIAL INVESTIGATIONS (CONTINUED)

‡-Diesel[b] ʀange ‡0/3550	TPH - Gasoline[b] Range	TPH Residual Range*	PCB*	Pesticides*	TDS	TSS	TOC	TCLP	TOTAL SAMPLES
:el 8100M	Gas 5030/8015M	Diesel 8100M	SW8080/8080M	SW8080/8080M	E160.1	E160.2	SW9060	SW1311	
NA	2 Water	NA	NA	NA	NA	NA	NA	NA	5 Water
: Water	11 Water	4 Water	6 Water	5 Water	2 Water	2 Water	6 Water	NA	9 Water
NA	2 Water	NA	NA	NA	NA	NA	NA	NA	3 Water
‡2 Soil	11 Soil	8 Soil	5 Soil	1 Soil	NA	NA	2 Soil	NA	13 Soil
: Water	2 Water	1 Water	NA	NA	1 Water	1 Water	1 Water	NA	2 Water
36 Soil 3 Water	127 Soil 44 Water	84 Soil 21 Water	48 Soil 14 Water	12 Soil 8 Water	16 Water	16 Water	18 Soil 20 Water	1 Water	138 Soil 52 Water

›ry at Barrow, Alaska.

TABLE 2-3. BACKGROUND ANALYTICAL DATA SUMMARY

Installation: Barter Island
Site: Background (BKGD)

Matrix: Soil/Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range	Environmental Samples: S01 & S04 (Replicates)		Environmental Samples: S02	S03	SD01	SD02	Field Blanks: AB01	EB01	TB02	Lab Blanks	
Laboratory Sample ID Numbers					4203-5	4203-4	4175-2 4203-6	4199-4	4199-1 4179-4	4199-7	4197-6 4173-9	4175-3 4203-8	4179-5 4199-13	4203 4179 4175 4173	4203 4199 4179 4175
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	9.55-1,150	588[cd]	466[cd]	384J[cd]	116[c]	9.55J[c]	195[c]	NA	<200	NA	<200	<4.00
GRPH	0.400	0.400-9	100	<0.400-<9	<1.40	<1.20	<0.800	<6.0	<0.400	<5.00	NA	<20	NA	<20	<0.400
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.325	<0.750	<0.250	<1.500	<0.100	<1.250					
Benzene	0.020	0.020-0.300	0.5	<0.020-<0.300	<0.065	<0.150	<0.050	<0.300	<0.020	<0.250	<1	<1	<1	<1	<0.020
Toluene	0.020	0.020-0.300		<0.020-<0.300	<0.065	<0.150	<0.050	<0.300	<0.020	<0.250	1.2	<1	<1	<1	<0.020
Ethylbenzene	0.020	0.020-0.300		<0.020-<0.300	<0.065	<0.150	<0.050	<0.300	<0.020	<0.250	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.040-0.600		<0.040-<0.600	<0.130	<0.300	<0.100	<0.600	<0.040	<0.500	<2	<2	<2	<2	<0.040
VOC 8010	0.020	0.020-0.300		<0.020-<0.300	<0.065	<0.150	<0.050	<0.300	<0.020	<0.300	<1-9.8	<1-2.5	<1	<1	<0.020
VOC 8260	0.020	0.025-0.050		<0.025-<0.500	NA	NA	<0.050	NA	<0.025	NA	<1-1.6	<1J-4.4J	<1	<1	<0.020
SVOC 8270	0.200	0.230-3.50		<0.230-<3.50	NA	NA	<3.50	NA	<0.230-<0.406	NA	NA	<10	NA	<10	<0.200
Pesticides	0.001	0.001-0.100		<0.001-<0.100	<0.06	<0.060	<0.005-<0.050	<0.100	<0.001	<0.080	NA	<0.1-<1	NA	<0.1-<1	<0.001-<0.020
PCBs	0.020	0.020-0.100	10	<0.020-<0.100	<0.060	<0.60	<0.050J	<0.100	<0.020	<0.020	NA	<1	NA	<1	<0.020
TOC				32,000-199,000	NA	NA	199,000	NA	32,000	NA	NA	7,800	NA	<5,000	NA

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.
a The action level for DRPH is based on conversations with ADEC; a final action level has not yet been determined.
c The laboratory reported that the Extractable Petroleum Hydrocarbon (EPH) pattern in this sample was not consistent with a middle distillate fuel.
d Laboratory reported that the sample is moss, and the EPH pattern may be due to biogenic hydrocarbons.

TABLE 2-3. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island | Matrix: Sediment
Site: Background (BKGD) | Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range	Environmental Sample	Field Blanks		Lab Blanks	
					2SD03	AB03	EB08		
Laboratory Sample ID Numbers					1746 4616-17	1712	1720 4616-13	#5-9693 #1&2-9693 #1&2-9493 4616	#6-9593 4616
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	9.55-1,150	1,150[cd]	NA	<1,000J[b]	<1,000J	<4.00
GRPH	0.400	9.0	100	<0.400-<9.0	<9.0[c]	<50J[b]	<50J[b]	<20	<0.400
RRPH (Approx.)	4.8	480	2,000[a]	<480	<480	NA	<2000	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.5				
Benzene	0.01	0.1	0.5	<0.020-<0.300	<0.1	<1	<1	NA	<0.02
Toluene	0.01	0.1		<0.020-<0.300	<0.1	<3J	<1J	NA	<0.02
Ethylbenzene	0.01	0.1		<0.020-<0.300	<0.1	<2J	<1	NA	<0.02
Xylenes (Total)	0.02	0.2		<0.040-<0.600	<0.2	<5J	<2	NA	<0.04
HVOC (8010 Mod.)	0.05	0.5		<0.5J	<0.5J	<9J	<5	NA	<0.1J
VOC 8260	0.020	0.500		<0.025-<0.500	<0.500	NA	<1	<1-6.6	<0.020

□ CT&E Data.
▩ F&B Data.
N/A Not available.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c These samples were analyzed by F&B also; and DRPH and GRPH were detected at <240[b] and <5J[b] mg/kg, respectively.
d Laboratory reported that the EPH result indicates possible biogenic hydrocarbon contamination; sample was a very wet moss.

TABLE 2-3. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Background (BKGD)

Matrix: Soil/Sediment
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Bkgd. Range	Environmental Samples					Field Blank		Lab Blanks
						S02	SD01				EB01		
Laboratory Sample ID Numbers						4175-2	4179-4				4175-3		4179 4175
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg				µg/L		µg/L
Aluminum	0.35	2		1,500-25,000	1,700-8,700	8,700	1,700				<100		<100
Antimony	N/A	2		<7.8-<230	<59-<91	<91	<59				<100		<100
Arsenic	0.11	2-9.1		<4.9-8.5	<9.1-7	<9.1	7				<100		<100
Barium	0.024	1		27-390	27-120	120	27				<50		<50
Beryllium	N/A	3.0-4.6		<2.6-6.4	<3.0-<4.6	<4.6	<3.0				<50		<50
Cadmium	0.33	3.0-4.6		<3.0-<36	<3.0-<4.6	<4.6	<3.0				<50		<50
Calcium	0.69	4		360-59,000	5,100-12,000	5,100	12,000				<200		<200
Chromium	0.066	1		<4.3-47	3-14	14	3.0				<50		<50
Cobalt	N/A	9.1-59		<5.1-12	<9.1-<59	<9.1	<59				<100		<100
Copper	0.045	1-3.0		<2.7-45	<3.0-14	14	<3.0				<50		<50
Iron	0.50	2		5,400-35,000	7,000-11,000	11,000	7,000				<100		<100
Lead	0.13	5.9-9.1		<5.1-22	<5.9-<9.1	<9.1	<5.9				<100		<100
Magnesium	0.96	4		360-7,400	2,500-4,800	2,500	4,800				<200		<200
Manganese	0.025	1		25-290	76	76	76				<50		<50
Molybdenum	N/A	3.0-4.6		<2.5-<11	<3.0-<4.6	<4.6	<3.0				<50		<50
Nickel	0.11	1		4.2-46	4.2-14	14	4.2				<50		<50
Potassium	23	100-300		<300-2,200	<300-970	970	<300				<5,000		<5,000
Selenium	1.2	9.1-59		<7.8-<170	<9.1-<59	<9.1	<59				<100		<100

☐ CT&E Data.
NA Not available.

TABLE 2-3. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Background (BKGD)

Matrix: Soil/Sediment
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Bkgd. Range	Environmental Samples					Field Blank		Lab Blanks
						S02	SD01				EB01		
Laboratory Sample ID Numbers						4175-2	4179-4				4175-3		4179 4175
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg				µg/L		µg/L
Silver	0.53	3.0-4.6		<3-<110	<3.0-<4.6	<4.6	<3.0				<50		<50
Sodium	0.55	5		<160-680	71-230	230	71				<250		<250
Thallium	0.011	0.3-0.45		<0.2-<1.2	<0.3-<0.45	<0.45	<0.3J				<5		<5
Vanadium	0.036	1		6.3-59	7.7-22	22	7.7				<50		<50
Zinc	0.16	1		9.2-95	11-24	24	11				<50		<50

☐ CT&E Data.
J Result is an estimate.

TABLE 2-3. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Surface Water Site: Background (BKGD) Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range	Environmental Samples				Field Blanks			Lab Blanks
					SW01	SW02			AB01	EB02	TB02	
Laboratory Sample ID Numbers					4199-6 4179-2	4199-5 4179-3			4197-6 4173-9	4179-1 4206-4	4197-5 4199-13	4173 4199 4179
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L			µg/L	µg/L	µg/L	µg/L
DRPH	100	200		<200	<200	<200			NA	<100	NA	<200
GRPH	20	20		<20	<20	<20			NA	<20	NA	<20
BTEX (8020/8020 Mod.)												
Benzene	1	1	5	<1	<1	<1			<1	<1	<1	<1
Toluene	1	1	1,000	<1	<1	<1			1.2	<1	<1	<1
Ethylbenzene	1	1	700	<1	<1	<1			<1	<1	<1	<1
Xylenes (Total)	2	2	10,000	<2	<2	<2			<2	<2	<2	<2
VOC 8010												
Chloroform	1	1		<1-1.1	<1	1.1			<1	<1-9	<1	<1
1,2-Dichloroethane	1	1	5	1.3B-2.8B	1.3B	2.8B			1.2	2.9	<1	<1
VOC 8260												
1,2-Dichloroethane	1	1	5	3U-3.2B	3U	3.2B			1.6	3.0	<1	<1
SVOC 8270	10	10		<10	<10	<10			NA	<11	NA	<10
Pesticides	0.05	1		<1	<1	<1			NA	<0.1-<1	NA	<0.1-<1

☐ CT&E Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
U Compound is not present above the concentration listed.

TABLE 2-3. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Surface Water Site: Background (BKGD) Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range	Environmental Samples				Field Blanks			Lab Blanks
					SW01	SW02			AB01	EB02	TB02	
Laboratory Sample ID Numbers					4199-6 4179-2	4199-5 4179-3			4197-6 4173-9	4179-1 4206-4	4197-5 4199-13	4199 4179
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L			µg/L	µg/L	µg/L	µg/L
PCBs	1	1	0.5	<1	<1	<1			NA	<1	NA	<1
TOC	5,000	5,000		<5,000-12,700	<5,000	12,700			NA	<5,000	NA	<5,000
TSS	100	100-30,000		<30,000-8,000	8,000J	<30,000			NA	4,000	NA	<100
TDS	10,000	10,000-352,000		<352,000-328,000	328,000	<352,000			NA	30,000	NA	<10,000

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.

TABLE 2-3. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Background (BKGD)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Bkgd. Levels	Environmental Samples					Field Blank			Lab Blank
						SW01	SW02					EB02		
Laboratory Sample ID Numbers						4179-2	4179-3					4179-1		4179
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L		µg/L
Aluminum	17.4	100		<100-350 (<100-340)	<100 (<100)	<100 (<100)	<100 (<100)					<100 (<100)		<100 (<100)
Antimony	N/A	100	6	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)					<100 (<100)		<100 (<100)
Arsenic	5.3	100	50	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)					<100 (<100)		<100 (<100)
Barium	1.2	50	2,000	<50-93 (<50-91)	<50-69 (<50-68)	69 (68)	<50 (<50)					<50 (<50)		<50 (<50)
Beryllium	N/A	50	4	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50 (<50)		<50 (<50)
Cadmium	1.7	50	5	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50 (<50)		<50 (<50)
Calcium	34.5	200		4,500-88,000 (4,100-86,000)	21,000-38,000 (21,000-38,000)	38,000 (38,000)	21,000 (21,000)					<200 (<200)		<200 (<200)
Chromium	3.29	50	100	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50 (<50)		<50 (<50)
Cobalt	N/A	100		<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)					<100 (<100)		<100 (<100)
Copper	2.3	50	1,300	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50 (<50)		<50 (<50)
Iron	25	100		180-2,800 (<100-1,600)	280-700 (<100-360)	280 (<100)	700 (360)					<100 (<100)		<100 (<100)
Lead	6.6	100	15	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)					<100 (<100)		<100 (<100)

☐ CT&E Data.
N/A Not available.

TABLE 2-3. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Background (BKGD)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Bkgd. Levels	Environmental Samples					Field Blank			Lab Blank
						SW01	SW02					EB02		
Laboratory Sample ID Numbers						4179-2	4179-3					4179-1		4179
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L		µg/L
Magnesium	47.8	200		<5,000-53,000 (2,600-54,000)	12,000-14,000 (13,000-14,000)	14,000 (14,000)	12,000 (13,000)					<200 (<200)		<200 (<200)
Manganese	1.24	50		<50-510 (<50-120)	<50 (<50)	<50 (<50)	<50 (<50)					<50 (<50)		<50 (<50)
Molybdenum	N/A	50		<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50 (<50)		<50 (<50)
Nickel	5.5	50	100	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50 (<50)		<50 (<50)
Potassium	1,154	5,000		<5,000 (<5,000)	<5,000 (<5,000)	<5,000 (<5,000)	<5,000 (<5,000)					<5,000 (<5,000)		<5,000 (<5,000)
Selenium	62.4	100	50	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)					<100 (<100)		<100 (<100)
Silver	2.6	50	50	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50 (<50)		<50 (<50)
Sodium	27.7	250		8,400-410,000 (8,200-450,000)	47,000-49,000 (50,000-57,000)	49,000 (50,000)	47,000 (57,000)					<250 (<250)		<250 (<250)
Thallium	0.57	5	2	<5 (<5)	<5 (<5)	<5 (<5)	<5 (<5)					<5J (<5)J		<5 (<5)
Vanadium	1.8	50		<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50 (<50)		<50 (<50)
Zinc	8.2	50		<50-160 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50 (<50)		<50 (<50)

☐ CT&E Data.
N/A Not available.
J Result is an estimate.

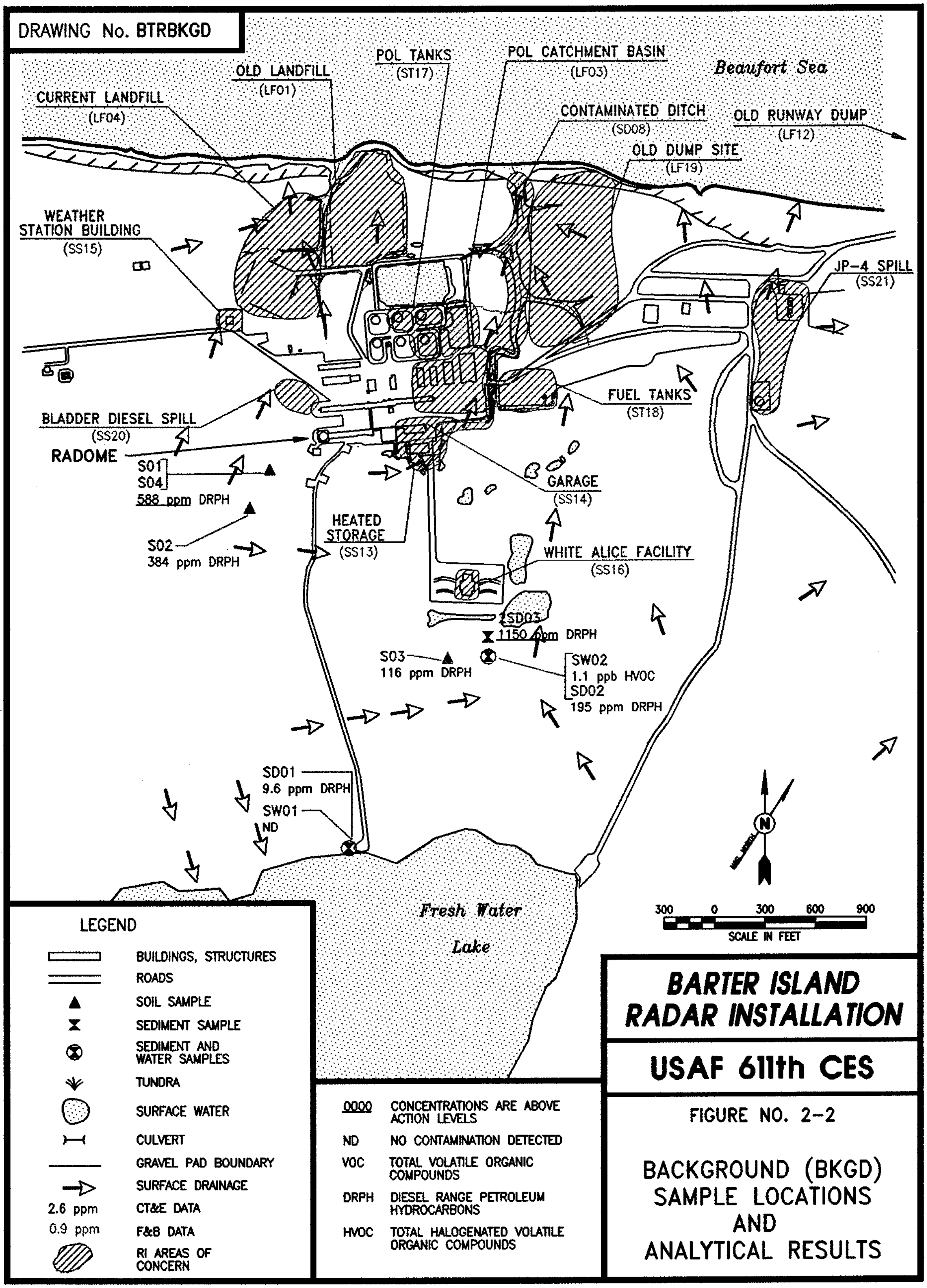

FIGURE NO. 2-2

BACKGROUND (BKGD)
SAMPLE LOCATIONS
AND
ANALYTICAL RESULTS

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at Barter Island. Detection and quantitation limits, action levels, and the associated field and laboratory blank results are included on the data summary table.

Below is a discussion of organic compounds and inorganic analytes detected in background samples at Barter Island. A discussion of TDS, TSS, and TOC is included. Analytical results are presented in Table 2-3 and Figure 2-2.

Organics. Only DRPH were detected in background soil and sediment samples. DRPH were detected in all seven of the background soil and sediment samples at concentrations ranging from 9.55 to 1,150 mg/kg. DRPH are assumed to be the result of naturally occurring biogenic hydrocarbons; DRPH in background samples were identified by the laboratory as not being consistent with middle distillate fuels. Although some naturally occurring compounds were detected in the DRPH analyses of some of the soil/sediment background samples, the organic concentration in background samples is assumed to be non-detect. This conservative approach was used because it is not possible to determine what degree, if any, the DRPH detected in site samples were naturally occurring compounds. The range of background concentrations detected for all analytes are presented in data summary tables for each of the 14 sites presented in Sections 3.0 and 4.0.

One organic compound was detected in background water samples collected at Barter Island. This compound, 1,2-dichloroethane, was detected in the two background water samples at 3.0 and 3.2 μg/L. This compound was also detected in associated blank samples and is assumed to be the result of field decontamination procedures. The hexane and methanol used in the decontamination procedures may have contained impurities including 1,2-dichloroethane. 1,2-Dichloroethane was detected at similar concentrations in numerous field blank samples.

Inorganics. Fourteen metals were detected in background soil/sediment samples at Barter Island. The results of inorganic analyses are presented in Table 2-3. TOC was reported at 199,000 and 32,000 mg/kg in samples BKGD-S02 and BKGD-SD01, respectively.

Five metals were detected in background surface water samples collected at Barter Island. The results of inorganic analyses are presented in Table 2-3. TOC was detected at 12,700 μg/L in surface water sample BKGD-SW02. TSS and TDS were detected at 8,000 and 328,000 μg/L, respectively, in surface water sample BKGD-SW01.

2.3.3 Laboratory Analyses

This section describes the RI analytical program. Summaries of the soil/sediment and water analyses conducted during the RI are presented in Tables 2-4 and 2-5. Table 2-4 presents a description of the soil analytical methods and number of soil samples collected, and Table 2-5 presents a description of the water analytical methods and the number of water samples collected during the RI.

TABLE 2-4. ANALYTICAL METHODS AND TOTAL NUMBER OF SOIL ANALYSES

SOIL ANALYSES	ANALYTICAL METHOD	REPORTING UNITS	NUMBER OF ANALYSES	REPLICATES	TOTAL ANALYSES
Volatile Organics	SW5030/8260	mg/kg	36	4	40
Semi-Volatile Organics	SW3550/8270	mg/kg	22	4	26
Total Metals Analysis --ICP Screen	SW3050/6010	mg/kg	18	3	21
TOC, Soil	SW9060	mg/kg	16	2	18
TPH - Diesel Range	SW3510/3550/8100M	mg/kg	124	12	136
TPH - Gasoline Range	SW5030/8015M	mg/kg	116	11	127
TPH - Residual Oil	SW3510/3550/8100M	mg/kg	76	8	84
BTEX	SW5030/8020/8020M	mg/kg	112	11	123
VOC 8010	SW5030/8010	mg/kg	26	3	29
Halogenated Volatile Organic Compounds	SW5030/8010M	mg/kg	33	3	36
PCB	SW5030/8080/8080M	mg/kg	43	5	48
Pesticides	SW5030/8080/8080M	mg/kg	11	1	12
TOTAL SOIL ANALYSES			633	67	700
TOTAL SOIL SAMPLES			125	13	138

M Modified.
N/A Not applicable.

TABLE 2-5. ANALYTICAL METHODS AND TOTAL NUMBER OF WATER ANALYSES

WATER ANALYSES	ANALYTICAL METHOD	REPORTING UNITS	NUMBER OF ANALYSES	TRIP BLANKS	AMBIENT CONDITION BLANKS	EQUIPMENT BLANKS	DUPLICATES	TOTAL ANALYSES
Volatile Organics	SW5030/8260	µg/L	16	4	2	8	1	31
Semi-Volatile Organics	SW3550/8270	µg/L	16	0	0	6	1	23
Total Metals Analysis –ICP Screen	SW3005/6010	µg/L	12	0	0	6	1	19
Dissolved Metals Analysis –ICP Screen	SW3005/6010	µg/L	12	0	0	2	1	15
TOC, Nonpurgable	SW9060	µg/L	13	0	0	6	1	20
Residue, Filterable (TSS)	E 160.2	µg/L	13	0	0	2	1	16
Residue, Filterable (TDS)	E 160.1	µg/L	13	0	0	2	1	16
TPH - Diesel Range	SW3510/3550/8100M	µg/L	31	0	0	10	2	43
TPH - Gasoline Range	SW5030/8015M	µg/L	27	2	2	11	2	44
TPH - Residual Oil	SW3510/3550/8100M	µg/L	16	0	0	4	1	21
BTEX	SW5030/8020/8020M	µg/L	26	4	3	9	2	44
VOC 8010	SW5030/8010	µg/L	6	2	1	2	0	11
Halogenated Volatile Organic Compounds	SW5030/8010M	µg/L	8	2	2	5	0	17
PCB	SW5030/8080/8080M	µg/L	8	0	0	6	0	14
Pesticides	SW5030/8080/8080M	µg/L	3	0	0	5	0	8
TCLP	SW1311	µg/L						1
TOTAL WATER ANALYSES			220	14	10	84	14	342
TOTAL WATER SAMPLES			32	5	3	9	2	52

2.3.3.1 Analytical Program. Analyses of samples were conducted by a fixed laboratory in Anchorage, Alaska, and a temporary laboratory set up at Barrow, Alaska. The analytical testing conducted by each laboratory is discussed below.

The fixed laboratory in Anchorage, Alaska, was operated by Commercial Testing & Engineering (CT&E). CT&E analyzed samples for the following constituents:

Analyses	Analytical Method
Volatile Organic Compounds (VOC)	SW5030/8260
Metals	SW3050 (Soil) 3005 (Water)/6010
Semi-Volatile Organic Compounds (SVOC)	SW3550 (Soil) 3510 (Water)/8270
Total Dissolved Solids (TDS)	E160.1
Total Suspended Solids (TSS)	E160.5
Total Organic Carbon (TOC)	SW9060
Moisture Content	ASTM D 2216
Toxicity Characteristic Leaching Procedure (TCLP)	SW1311

In addition, for the first few weeks of the field activities, CT&E provided the following analyses on a quick turnaround basis:

Analyses	Analytical Method
Halogenated Volatile Organic Compounds (HVOC)	SW5030/8010
Benzene, Toluene, Ethylbenzene, and Xylene (BTEX)	SW5030/8020
Gasoline Range Petroleum Hydrocarbons (GRPH)	8015 Modified
Diesel Range Petroleum Hydrocarbons (DRPH)	8100 Modified
Polychlorinated Biphenyls/Pesticides	SW5030/8080

The temporary laboratory in Barrow, Alaska was operated by Friedman & Bruya (F&B) of Seattle. F&B analyzed samples for the following constituents:

Analyses	Analytical Method
Halogenated Volatile Organic Compounds (Four compounds only)	SW5030/8010 Modified
Benzene, Toluene, Ethylbenzene, and Xylene	SW5030/8020 Modified
Polychlorinated Biphenyls/Pesticides	SW3550/8080 Modified
Diesel Range Organics (DRO)	8100 Modified
Gasoline Range Organics (GRO)	8010/8020/8015 Modified
Residual Range Organics	8100 Modified

Analytical methods used during sample analyses for this project are summarized in Tables 2-4 and 2-5 and are developed from the reference methods described in the following sources:

- *Test Methods for Evaluating Solid Waste (Physical/Chemical Methods)* Third Edition, EPA SW-846. September 1986.

- *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020. March 1983.

- *Standard Methods for the Examination of Water and Wastewater*, APHA/AWWA, 17th Edition. 1989.

- *Interim Guidance for Non-UST Soil Cleanup Levels*, Alaska Department of Environmental Conservation. July 1991.

Project-specific analytical methods and procedures, target analytes, quantitation limits, and acceptance criteria are presented in the RI/FS SAP (U.S. Air Force 1993b).

2.3.4 Chronology of Laboratory Analyses

Laboratory analyses conducted by the temporary laboratory, F&B, in Barrow, Alaska, were conducted on a quick-turnaround basis. The samples collected at Barter Island radar installation were analyzed by this laboratory during the period from 23 August to 7 September 1993.

Analyses at the CT&E laboratory in Anchorage, Alaska, were conducted between 20 August and 21 October 1993. These analyses included a few quick-turnaround analyses but primarily standard-turnaround analyses.

2.3.5 Laboratory QA/QC Programs

The QA objectives for this project were achieved through implementation of specific procedures for sampling, chain-of-custody, calibration, laboratory analyses, data validation and reporting, internal QC, audits, preventive maintenance, and corrective actions.

A detailed description of QA/QC measures, frequency, and corrective actions used by both labs is presented in the Quality Assurance Project Plan (QAPjP) (Section 1 of the RI/FS SAP [U.S. Air Force 1993b]). Ultimately, the relevant laboratory SOPs provide full and detailed guidance regarding all method-specific laboratory QA/QC criteria and appropriate corrective actions.

Data quality for the organic analyses was monitored by the laboratory through a QA program that included analyses of initial and continuing calibrations, method blanks, surrogate spikes, internal standards, matrix spikes and matrix spike duplicates, and laboratory control samples. The identification of target analytes at levels above the detection limit was confirmed by gas chromatography/mass spectrometry (GC/MS) or analysis on a GC equipped with a different column (second column confirmation).

Data quality for the inorganic analyses was monitored through a QC program that included analyses of initial and continuing calibrations, laboratory control samples, method blanks, duplicate samples, post-digestion analytical spikes, and matrix spikes.

Laboratory QC samples were analyzed at a rate of at least one per 20 determinations. See the RI/FS QAPjP for laboratory-specific criteria for the frequency of QC sample analyses and corrective actions regarding QC analyses.

2.3.6 Data Validation and Reporting

Data validation is a systematic process of reviewing a group of sample data to provide assurance that the data are adequate for their intended use. The validation activities were performed in accordance with the following EPA documents to the extent that they were applicable:

- *Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses*. EPA. Hazardous Site Evaluation Division. December 1990.
- *Laboratory Data Validation Guidelines for Evaluating Inorganic Analyses*. EPA. Hazardous Site Evaluation Division. October 1989a.
- *Test Methods for Evaluating Solid Waste (Physical/Chemical Methods)* Third Edition, EPA SW-846. September 1986.

Prior to releasing data for use by project staff, selected data packages underwent a formal validation procedure to examine laboratory compliance with QA requirements and other factors that determine the quality of the data. The organic validation was performed by the prime contractor in accordance with the EPA Functional Guidelines for Evaluating Organic Analyses. The following factors were examined:

- Sample holding times;
- Sample chain-of-custody;
- GC/MS tuning criteria;
- Initial and continuing calibration;
- Method blanks;
- Practical quantitation limits;
- Laboratory blank contamination;
- Surrogate spike recoveries;
- Matrix spike/duplicate analysis;
- Field duplicate analysis;
- Ambient condition blank contamination;
- Trip blank contamination;
- Internal standard area;
- Pesticide instrument performance;
- Compound identification criteria; and
- Analyte identification and quantitation.

The inorganic data validation was performed in accordance with the EPA Functional Guidelines for Evaluating Inorganic Analyses. Parameters evaluated include:

- Holding time;
- Blank results;
- Instrument calibration;
- Inductively Coupled Plasma (ICP) Spectroscopy interference check analysis;
- Laboratory Control Samples;
- Duplicate analysis;
- Spike analyses;
- Furnace analyses (spikes and duplicates);
- Serial dilution;
- Detection limits; and
- Analyte quantitation.

When a data package was received from the laboratory, the analytical results and associated QA/QC documentation were reviewed for technical compliance, and data validation reports were prepared summarizing the QA/QC parameters. The review included evaluation of laboratory and field blank sample data, and review of all data for accuracy, precision, and completeness.

A cross-section of CT&E analytical data, representing approximately 15 percent of all the CT&E analyses, underwent formal data validation. Because some reporting errors were found in the F&B analytical data, 100 percent of the F&B data was validated. Once the validation for a batch of samples was completed, a validation report was prepared. The report highlights all the QC criteria evaluated, and notes any major deficiencies or QA problems. Although a minimal amount of analytical data was rejected during data evaluation, the acceptable and valid data from CT&E and F&B are sufficient to meet the project objectives. The data validation reports for data generated by CT&E and F&B are presented in Appendix G.

2.4 METHODOLOGY FOR RISK ESTIMATION

This section describes the methods used to determine the potential risks to human and ecological receptors from chemicals detected in samples collected from the 14 sites at the installation. A summary of the risks posed by chemicals detected at each of the sites is presented on a site-by-site basis in Sections 3.0 and 4.0. The complete human health and ecological risk assessments are presented in the Barter Island Risk Assessment (U.S. Air Force 1996), which has been submitted under separate cover.

In addition to the methods for risk evaluation, this section presents contaminant fate and transport, general potential migration pathways, and receptor groups common to all of the Barter Island sites.

2.4.1 Human Health Risk

The evaluation of human health risk was conducted in accordance with standard risk assessment methodology as described in *Risk Assessment Guidance for Superfund (RAGS): Human Health Evaluation Manual, Part A* (EPA 1989b), *Region 10 Supplemental Risk Assessment Guidance for Superfund* (EPA 1991a), and the *Handbook to Support the Installation Restoration Program Statements of Work* (U.S. Air Force 1991a). This section presents a summary of the approach used in evaluating the human health risks associated with the sites at the Barter Island radar installation.

The Barter Island DEW Line installation presented a unique challenge to the development of a human health risk assessment. Many of the conventional assumptions applied to risk assessments do not apply to the North Slope of Alaska. Barter Island is remote and sparsely populated. Native residents, largely Inupiats, follow a lifestyle that includes a significant subsistence component; much of their food consists of mammals (whales, seals, moose, and caribou), aquatic life (Arctic char), and birds (ptarmigan and ducks) that are abundant in this area of the arctic. The climate is generally harsh, and the soil and surface water are frozen for approximately nine months of the year. The following paragraphs present some of the approaches and assumptions used in the development of the human health risk assessment.

The general approach to the human health risk assessment was to quantify the excess lifetime cancer risk and the noncancer hazard associated with exposure to the site contaminants detected at each of the 14 sites at the installation. The maximum concentration of each chemical detected is used at the exposure point concentration instead of an arithmetic mean of 95 percent percentile upper confidence limit (UCL) because contamination was infrequently detected and found to be generally of low concentration. Incorporating nondetects into the calculation of an average of UCL when the frequency of positive detects is low tends to yield low and unreliable estimates of contamination. Use of the maximum concentration yields a more conservative estimate of risk or hazard.

Chemical concentrations detected in soil/sediment and surface water samples from each of the sites were compared to risk-based screening levels (RBSLs), ARARS, and background concentrations. A chemical was selected as a COC if the maximum concentration at which the chemical was detected exceeded the corresponding background concentration, and the RBSL (based either on cancer risk or noncancer hazard) or an ARAR. In addition, chemicals detected above background levels were retained as COCs if no RBSL or ARAR were available. COCs selected in this manner were evaluated in the human health risk assessment.

An exposure pathway describes the course a chemical will take from a source to an exposure point where a receptor can come into contact with the chemical. The exposure pathways by which exposure to COCs at Barter Island may occur include ingestion, dermal contact, and inhalation. The dermal contact and inhalation pathways were not considered complete or significant because the arctic climate precludes dermal contact with and volatilization of site contaminants, so they were not evaluated. Exposure pathways that were considered for all sites were incidental ingestion of soil/sediment and ingestion of surface water.

Three potential receptor groups were evaluated in the risk assessment: an adult assigned to a DEW Line installation (worker), an adult inhabitant of a community in the North Slope of Alaska (native), and a child living in a North Slope community (child).

The risk assessment assumed a residential scenario when estimating the soil/sediment and water ingestion rates. The soil/sediment ingestion rate was based on EPA default values, 100 mg/day for adults and 200 mg/day for children. The drinking water ingestion rate assumed the surface water where chemicals were detected at the site will be used as a source of drinking water for 180 days per year at the EPA default ingestion rate of 2 liters per day.

The exposure duration assumed a DEW Line worker would be stationed at the Barter Island installation for 10 years. The exposure duration for the native was estimated at 55 years. EPA's default reasonable maximum exposure duration is 30 years; however, this is based on the residence time in one location for the continental United States. Because Alaskan natives are more likely to remain in North Slope communities for a longer period, 55 years was determined to be a more appropriate estimate of residence time.

The risk assessment was based on the assumptions above, along with chemical-specific toxicity data, to quantitatively and qualitatively express the hazards and risks. To characterize potential noncancerous effects, comparisons were made between projected intakes of substances and chemical-specific toxicity values. The potential noncancerous health effects were expressed as a hazard quotient (HQ). To assess the overall potential for noncancerous effects posed by more than one chemical at a site, the hazard quotients were summed and reported as the hazard index. An HQ or hazard index of 1.0 is the regulatory benchmark. Noncancer hazards greater than 1.0 are generally considered a concern, and noncancer hazards of less than 1.0 are generally considered not to warrant further evaluation.

To characterize the potential for carcinogenic effects, the probability that an individual will develop cancer over a lifetime of exposure, the risks were estimated from projected intakes of the COCs and chemical-specific dose-response information. The cancer risks are calculated on a chemical-specific basis and are added together (if more than one chemical associated with cancer risk is a COC at the site) to estimate the total cancer risk for the site. The total cancer risk for each pathway is generally not considered to be of concern unless it exceeds a value of 1×10^{-6}.

Excess lifetime cancer risk is the incremental increase in the probability of developing cancer during one's lifetime over and above the background probability of developing cancer (i.e., if no exposure to site chemicals occurs). For example, a 1×10^{-6} excess lifetime cancer risk means that, in a population of one million people exposed to the carcinogen throughout their lifetimes, the average incidence of cancer may increase by one case. The background probability among Americans of developing cancer at some time in their lives is about one in four (American Cancer Society 1993). The calculation of cancer risks uses information (i.e., cancer slope factors) developed by the EPA that represents upper bound estimates, so any cancer risks estimated in the risk assessment should be regarded as upper bounds on the potential cancer risks rather than accurate representations of true cancer risk. The true cancer risk is likely to be lower than that predicted (EPA 1989a).

Excess lifetime cancer risk and noncancer hazard were calculated for the soil/sediment ingestion and water ingestion pathways. Other pathways were eliminated from consideration as described in the Barter Island Risk Assessment (U.S. Air Force 1996). The risks and hazards associated with chemicals detected at the Barter Island sites are presented on a site-by-site basis in Sections 3.0 through 5.0 of this RI/FS report.

2.4.2 Ecological Risk

The objective of the ERA is to estimate potential impacts to aquatic and terrestrial plants and animals at the Barter Island DEW Line installation. The evaluation of environmental risks was conducted in accordance with current Air Force and EPA guidance, specifically, *Handbook to Support the Installation Restoration Program Statements of Work* (U.S. Air Force 1991a), *Framework for Ecological Risk Assessment* (EPA 1992), and *Ecological Risk Assessment Guidance for Superfund* (EPA 1994).

The approach used to assess potential ecological impacts was conceptually similar to that used to assess human health risks. Potentially exposed populations (receptors) were identified, and information on exposure and toxicity was combined to derive estimates of risk. However, the scope of ERAs is generally different from that of human health risk assessments in that ecological assessment focuses on potential impacts to populations of organisms rather than to individual organisms (except in the case of endangered species where individuals are considered). In addition, because ecosystems are composed of a variety of species, ecological assessments evaluate potential impacts to numerous species instead of a single species (as is the case in human health assessments).

Ideally, ERAs should evaluate potential risks to communities and ecosystems, as well as to individual populations. However, because of the large number of species and communities present in natural systems, such ecosystem-wide assessments are very complex and appropriate assessment methodologies have not yet been developed. In addition, dose-response data on community or ecosystem responses are generally lacking. Therefore, evaluations of potential impacts to communities or ecosystems are qualitative.

The degree to which potential ecological impacts can be characterized is highly dependent upon the data available to support such estimates. Data required include information regarding contaminant release, transport, and fate; characteristics of potential receptor populations; and adequate supporting toxicity data for the COCs. The degree to which the existing database can meet these requirements dictates the extent to which potential ecological impacts can be evaluated.

Ecological receptors can be exposed to COCs through abiotic and biotic media. Potential exposure pathways for terrestrial and aquatic organisms include direct contact and ingestion of contaminated soil/sediment and/or surface water. The most significant route of exposure for plants is direct contact with soil. Aquatic organisms such as fish and invertebrates are primarily exposed through direct contact with surface water, but may be exposed to COCs through ingestion of plant and animal items in the diet, and incidental ingestion of soil/sediment while foraging (although only direct contact with surface water is used to develop risk estimates). Birds

and mammals may be exposed to COCs through ingestion of surface water, ingestion of plant and animal diet items, and incidental ingestion of soil/sediment.

The potential ecological receptors evaluated in the risk assessment include plants, aquatic organisms, birds, and mammals likely to occur along the Arctic Coastal Plain. Representative species from these groups of receptors were selected based primarily on the species' likelihood of exposure given their preferred habitat and feeding habits. Species that may be particularly sensitive to environmental impacts, such as endangered or threatened species, were also evaluated. The representative species, including threatened and endangered species, are presented in Table 2-6. Any threatened or endangered species evaluated in the ERA are not considered representative of the Arctic Coastal Plain or the DEW Line installations. These species are evaluated to provide information about whether they face potential risks from exposure to COCs.

Potential risks to representative species were estimated by evaluating sampling data for the relevant exposure media (i.e., soil/sediment and surface water). Potential risks to plants were evaluated by comparing the average contaminant concentrations in the site soil/sediment to toxicity information in the literature. Potential impacts on aquatic receptors were evaluated by comparing average surface water concentrations to toxicity reference values (TRVs). Potential impacts to birds and mammals were evaluated for selected representative species by comparisons of estimated exposures, based on potential dietary intakes of COCs, to TRVs. TRVs for representative species are derived by selecting toxicity values from the literature and extrapolating to the species of concern. TRVs are then divided into the estimated exposure concentration to derive the HQ. If the HQ is less than one, then adverse effects are not expected. Conversely, if the HQ is equal to or greater than one a potential for adverse effects exists. The confidence level of the risk estimate is increased as the magnitude of the HQ departs from 1.0. For example, there is greater confidence in a risk estimate where the HQ is 0.1 or 10, than in an HQ such as 0.9 to 1.1.

TRVs are calculated to be protective of long-term exposures. This is accomplished by using chronic chemical and receptor-specific no-effect dosages as starting points when such data is available. If chronic or receptor-specific data is not available, then uncertainty and scaling (to account for differences in body size) factors are incorporated in the derivation of the TRVs. This is standard practice in ERAs and is illustrated in screening level benchmarks used in the ERA for sediments (Hull and Suter 1994), aquatic biota (Suter and Mabrey 1994), and wildlife (Opresko et al. 1994). The assumptions incorporated in the ERA assume daily exposure during the receptor's most sensitive life stage (i.e., one breeding season). Consequently, if no risks are identified at the "chronic" level, there will be no risk related to "acute", or occasional exposures. This should be kept in mind when interpreting the HQ. Although the HQ may be greater than one, the conservatism embodied in the TRV, and assumptions of the ERA, allow for mitigating factors (e.g., large home range, short seasonal exposure, unlikely repeated exposures at a "hot spot" location) that may result in a finding of no significant risk.

TABLE 2-6. REPRESENTATIVE AND SENSITIVE SPECIES AT THE DEW LINE INSTALLATION SITES

COMMON NAME	GENUS AND SPECIES
Sedge	*Carex* spp.
Cottongrass	*Eriophorum* spp.
Willow	*Salix* spp.
Berries	*Vaccinium* spp.
Water fleas	*Daphnia* spp.
Nine-spined stickleback	*Pungitius pungitius*
Arctic char	*Salvelinus alpinus*
Lapland longspur	*Calcarius lapponicus*
Brant	*Branta bernicla*
Glaucous gull	*Larus hyperboreus*
Pectoral sandpiper	*Calidris melanotos*
Brown lemming	*Lemmus trimucronatus*
Arctic fox	*Alopex lagopus*
Spectacled eider[a]	*Somateria fischeri*

a This species is listed as threatened under the Endangered Species Act.

The ERA was intended to be at a screening level, rather than a full scale investigation of the state of the ecosystem. No specific onsite studies of the biota were undertaken. The assessment was based on media sampling (i.e., surface water and soil/sediment samples). The ecological risks associated with the chemicals detected at the Barter Island sites are presented site-by-site in Sections 3.0 through 5.0 of this RI/FS report. The complete ERA is presented in the Section 3.0 of the Barter Island Risk Assessment (U.S. Air Force 1996).

2.4.3 Contaminant Fate and Transport

The fate and transport of the COCs in soil/sediment and surface water have been accounted for in the sampling plan. Known source areas were sampled, and the extent of migration was evaluated by sampling at increasing distances from the source area. Surface and subsurface sampling was conducted in gravel pads and tundra areas to characterize the extent of contaminant migration. Ground water was not evaluated because subsurface water flow occurs only in the active layer over the permafrost, and ground water is not used for domestic purposes.

Surface water samples were collected in streams and ponds and analyzed to evaluate the migration of contamination from source areas to water bodies potentially used by human or ecological receptors. The potential for contaminant migration is discussed on a site-specific basis in Sections 3.0 through 5.0.

2.4.4 General Migration Pathways

This section presents general information concerning migration pathways for the 14 sites at the Barter Island radar installation. Site-specific migration pathways are presented in Sections 3.0 through 5.0.

The potential for contaminant migration exists for any site where a release has occurred. The threat that a contaminated site presents to human health or the environment was assessed according to the potential for contaminant migration, human or ecological receptors, and contaminant concentrations to which the receptors may be exposed.

There are three main pathways through which contaminants may reach human and ecological receptors. These pathways are subsurface migration (in affected active layer water), surface migration, and air transportation (as vapors or dust). Potential migration pathways are depicted in Figure 2-3. Figures 2-4 and 2-5 present the potential exposure pathways for the human and ecological receptors, respectively. The discussion of migration pathways is preceded by a general description of the topography and stratigraphy at Barter Island.

2.4.4.1 Topography. Little topographic relief is expressed at the Barter Island installation. In general, the tundra is flat or very slightly sloping. The maximum elevation on Barter Island is 55 feet above MSL, and drainage is radially away from the high points. The Barter Island installation is situated adjacent to the northern coast of the island. Up slope from the installation is a freshwater lake used as a drinking supply for the station and Kaktovik village. Kaktovik village is located cross-slope from the station, adjacent to Kaktovik Bay.

The greatest relief on the island is at incised streams and beach bluffs. Incised streams were observed to reach a maximum depth of approximately 15 feet from the top of the tundra to the surface water elevation in the stream. Beach bluffs, where the tundra drops abruptly down to the beach, also had a relief of approximately 15 feet. Gravel pads and roads, which are of human origin, rise approximately four to five feet above the tundra. The edges of these features are sloped at the angle of repose for unconsolidated sands and gravels.

The most prominent topographic features, visible from the air and ground surface, are ice wedge polygons. These features are formed by cracking of the ground surface during thermal contraction, followed by the infiltration of water. The water then freezes and forces the crack wider. Repeated freeze-thaw cycles enlarge these features, which form small troughs and may fill with water. Intersecting troughs form polygonal arrangements, which range from a couple of feet to tens of feet across.

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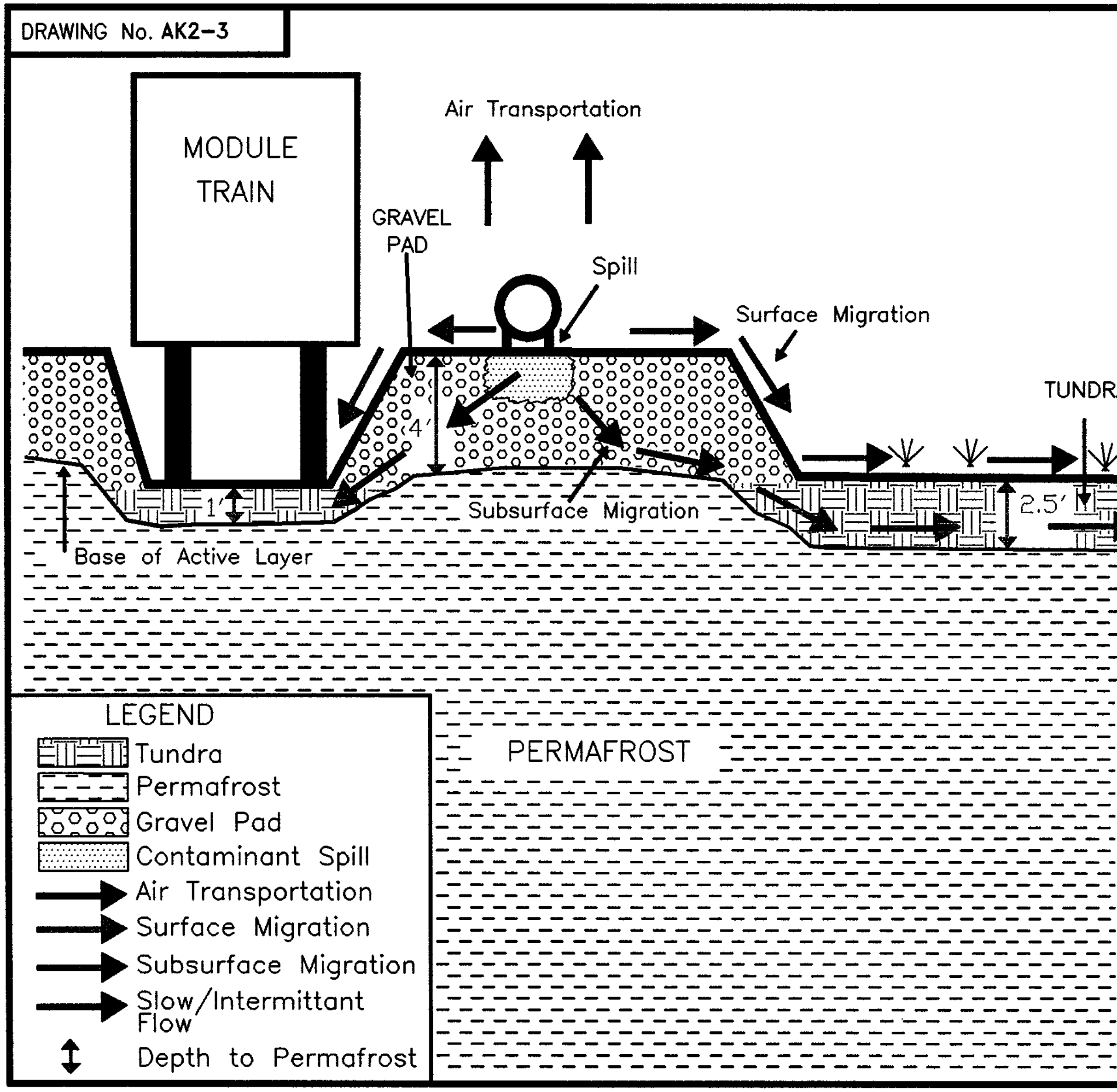

ALASKA REMOTE RADAR INSTALLATIONS

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FIGURE NO. 2-3

POTENTIAL MIGRATION PATHWAYS

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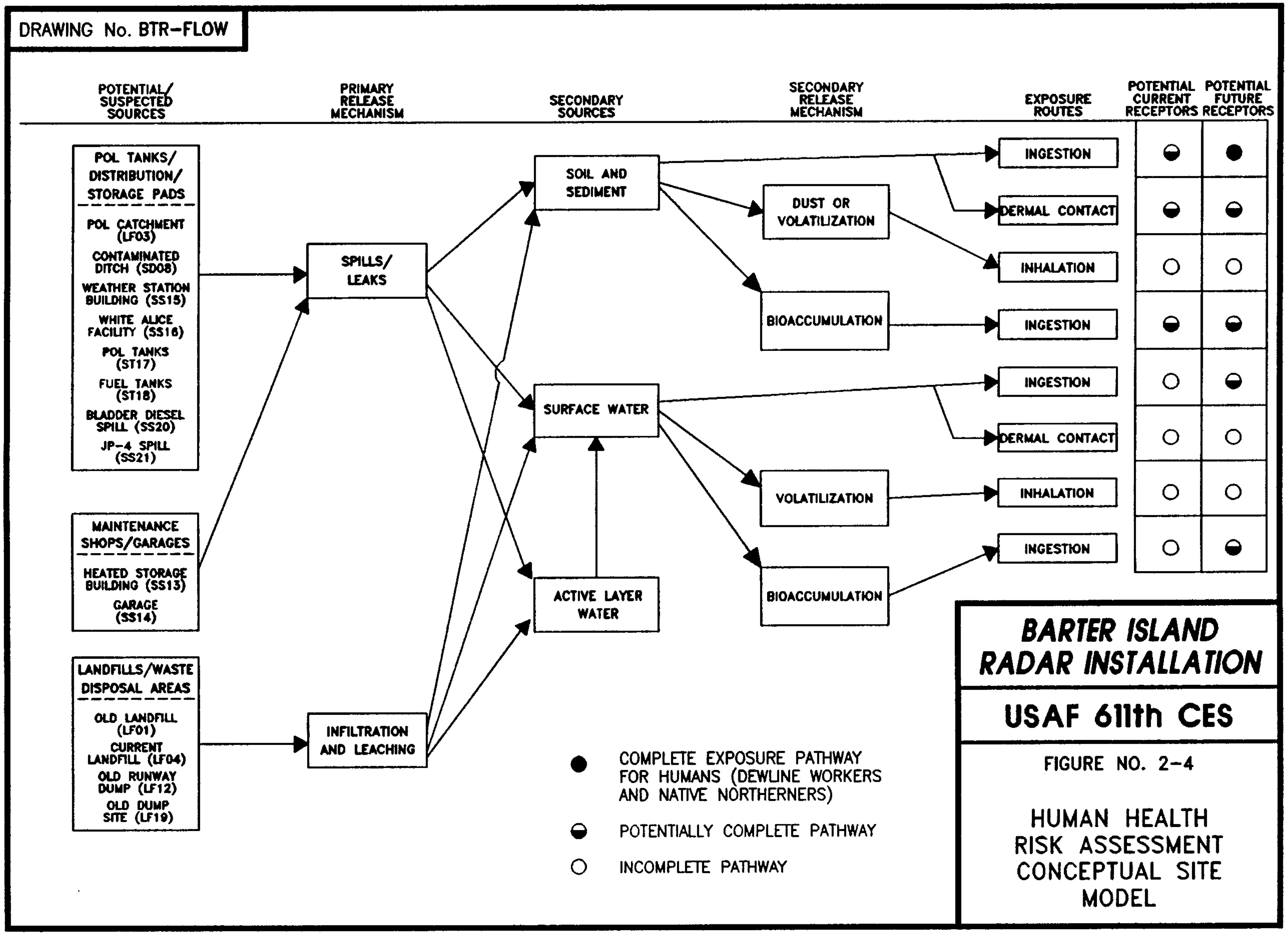

FIGURE NO. 2-4

HUMAN HEALTH RISK ASSESSMENT CONCEPTUAL SITE MODEL

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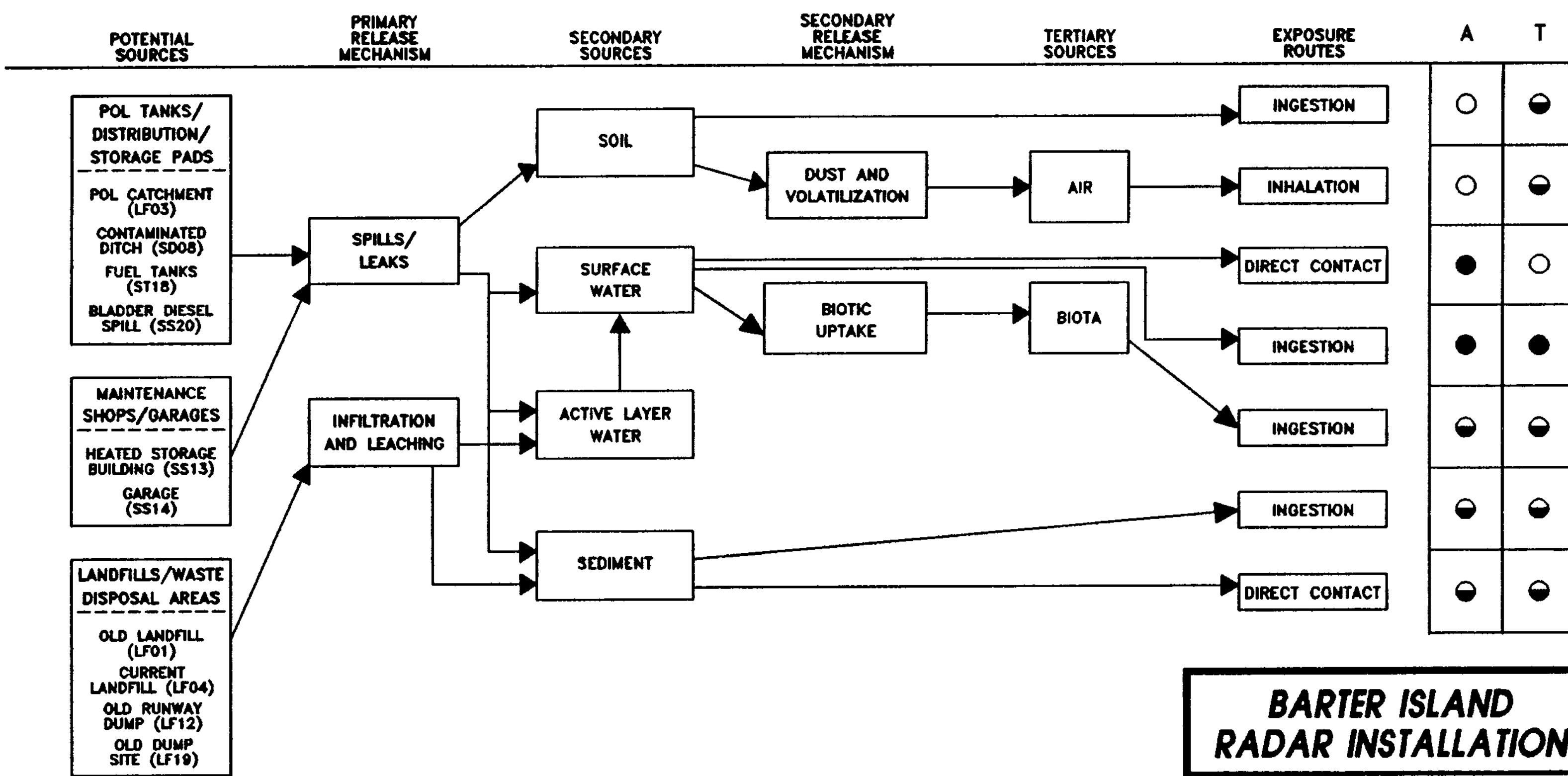

A AQUATIC RECEPTORS

T TERRESTRIAL RECEPTORS

● COMPLETE EXPOSURE PATHWAY

◒ POTENTIALLY COMPLETE PATHWAY

○ INCOMPLETE OR INSIGNIFICANT EXPOSURE PATHWAY

BARTER ISLAND RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 2-5

ECOLOGICAL RISK ASSESSMENT POTENTIAL EXPOSURE PATHWAYS

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Two types of ice wedge polygons exist: low centered and high centered. In low centered polygons, the middle of the polygon is depressed to form a small basin, which may fill with water. A cross-section of one of these basins would reveal an ice-wedge trough on either side of the polygon, berms lining both sides of the troughs, and a basin filling the interior space between the berms. A high centered polygon does not have a depressed center, and consists of intersecting troughs with higher ground in the middle.

Another prominent tundra feature consists of oriented lakes. These lakes, which form from low centered polygons, are enlarged by the erosional action of wind-induced waves. These lakes are generally not circular but oblong, with the long axis of the lake normal to the prevailing wind direction. They can "migrate" across the tundra at an average rate of three feet per year (Livingstone 1954), and have a stable depth of approximately 10 feet (Hussey and Michaelson 1966).

2.4.4.2 Stratigraphy. The stratigraphy at Barter Island was examined during RI activities down to the level of the permafrost (generally no deeper than two to four feet). The upper-most features at the site are gravel roads and pads of human origin. These features, which are limited in areal extent, have a maximum height of approximately six feet. They generally consist of well graded sandy gravels with sub-angular to sub-rounded, very fine to coarse sands and sub-angular to sub-rounded gravel clasts ranging from one-quarter inch to one and one-half inches (although gravel clasts ranging up to four inches or more are occasionally encountered). The grains are unconsolidated, and fine material (silts or clays) may be present in minor quantities. The depth to permafrost under the surfaces of gravel pads and roads ranged from two to four feet during August and September 1993.

Gravel pads and roads were constructed on top of native tundra, which occurs throughout the site. The top of the tundra consists of a vegetative mat, in a loamy/silty matrix. This mat can reach several inches in thickness. Underlying the tundra mat are fine to coarse sands and gravels, dark brown organic clays, and silt layers. The depth to permafrost beneath the tundra was approximately two feet during the 1993 RI. Adjacent to the Beaufort Sea, beaches are present that consist of poor to well sorted, sub-rounded to rounded, fine to coarse sands, and sub-rounded to rounded gravel clasts of varying size; minor amounts of fine material are also present.

2.4.4.3 Subsurface Migration. Active layer water flow under the tundra is hampered by the presence of numerous wet depressions and the relatively flat topography; because the depth to permafrost under these depressions is increased, they tend to act as small catchment basins. These basins limit the potential for the horizontal flow of active layer water (Miller et al. 1980; Robertson 1988). The active layer water flow in these areas is so inhibited that it can contribute little to the midsummer water budget of tundra streams. Most of the active layer water contribution to these streams is from immediately adjacent well drained slopes (Robertson 1988).

Some generalizations about active layer water flow can be made. Due to the combined effects of low topographic relief and the presence of numerous catchment basins, active layer water migration through areas of tundra is a slow process. The active layer water contribution to tundra streams is mainly from well drained slopes next to those streams. The active layer water

flow that does occur is governed by changes in topographic relief and is limited to spring and summer months, with the active layer functioning as a shallow, unconfined aquifer. The water table in such an aquifer tends to mimic topographic features, and active layer water flow is driven by elevation changes. Figure 2-6 illustrates how the elevation changes of gravel roads and berms can restrict active layer water flow.

2.4.4.4 Surface Migration. Surface migration at Barter Island may occur as a result of the flow of surface water from topographic highs to topographic lows. Surface water flow during the spring thaw, when mounds of snow can channel drainage in unexpected directions, can be markedly different from flow during the summer months. The general surface migration features and directions are depicted in Figure 1-8.

The main factors controlling surface water flow are the topography and water availability. The topography at the Barter Island station has relatively little relief; therefore, there is only a small gradient to drive surface water flow. Combined with the depressions formed by the ice wedge polygons, this creates a multibasinal drainage pattern in which much of the surface water is directed into depressions and small tundra ponds, rather than draining directly into drainage channels.

Based upon precipitation alone, Barter Island could classify as a desert (Robertson 1988). Precipitation along the Beaufort Sea coast averages only seven inches per year (Dingman et al. 1980; Walker et al. 1980). Additionally, 65 percent of the precipitation on the North Slope is in the form of snow (Walker et al. 1980). Most surface water flow occurs during the spring, when melting snow and ice release stored water over a relatively short time-frame and the active layer remains partially frozen. This creates a situation in which there is a large supply of surface water and very little capacity for infiltration. The result is the overland sheet flow of surface water (Robertson 1988), during which drainage is not confined to local drainage features but may travel in a sheet-like fashion over the topography. Snow, ice, and man-made features (gravel pads and roads) may also result in barriers that force the flow of surface water in directions different from those dictated by the underlying ground surface.

There is comparatively little flow of surface water during the summer. In fact, Arctic wetlands exist because the lack of significant vertical relief retards the horizontal flow of surface water, and permafrost limits downward flow (Robertson 1988). Overflow from tundra ponds is generally dependant upon summer rainfall.

The potential for contaminant migration in surface water is therefore greatest during the spring thaw, which is of relatively short duration, and during which the precise direction of flow may be difficult to determine.

There are three main streams that drain the area surrounding the Barter Island installation, as well as several smaller rills that drain the area immediately adjacent to the ocean (Figure 1-8). Two of the main streams are well defined and have incised to base level at the ocean. One of these streams that runs through the Contaminated Ditch site drains the eastern portion of the site. The other stream (which runs along the western edge of the Old Landfill) drains the western portion of the site. These drainages were observed to discharge from 13 to 19 gallons per minute (gpm)

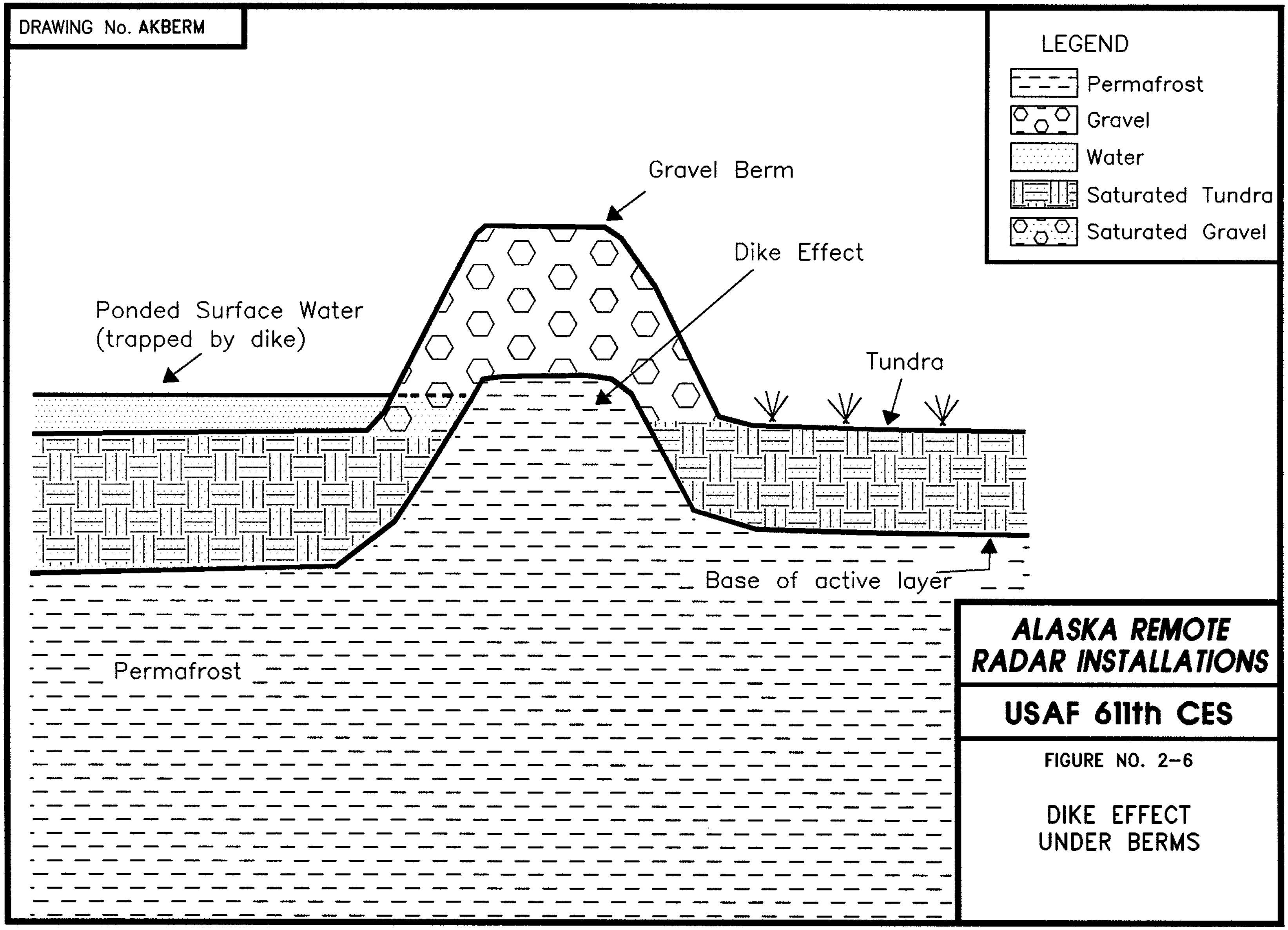

FIGURE NO. 2-6

DIKE EFFECT
UNDER BERMS

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and from 36 to 67 gpm, respectively, during the late summer of 1988 (Woodward-Clyde 1990). The third main drainage is poorly defined and winds through saturated tundra near the eastern edge of the Old Landfill site. This stream is located just north of the sewage lagoon, and may receive subsurface infiltration from this feature. Discharge from this stream has not been estimated; however, the flow appears to be much lower than that of the other two streams.

2.4.4.5 Air Transport. Air transportation of contaminants is not considered to be a significant migration pathway at Barter Island. The frozen conditions encountered most of the year are not conducive to the volatilization of organic contaminants or to the transport of affected dust and dirt. During the summer months, the air and ground temperatures remain relatively low (reducing volatility) and the abundant supply of moisture retards the entrainment of affected dust.

2.4.5 Receptors

Three potential human receptor groups were evaluated for the Barter Island risk assessment: an adult assigned to a DEW Line installation (worker), an adult native of the North Slope of Alaska (native), and a native child (child). The first two receptor groups represent the reasonable maximum exposure at an installation that is not in close proximity to a native village. Because the radar installation is close to a village, a child was considered as a potentially exposed individual.

The primary routes of human exposure evaluated in the Barter Island risk assessment are incidental ingestion of soil and ingestion of surface water.

For the ecological evaluation it was assumed that terrestrial and aquatic species are potential receptors for at least the six months of the year when the region is not ice and snow covered. In addition, it was assumed that species that occur at great distances from the specific installations are not receptors (e.g., whales). Whales may migrate off-shore from the DEW Line sites; it is unlikely, however, that these mammals are potential receptors to COCs released from the sites because of dilution of surface water entering the Arctic Ocean and the distance off-shore that these animals migrate. Potential ecological receptors evaluated in the ERA were discussed in Section 2.4.2.

The potential human health and ecological risks to receptors associated with the contaminants detected at the Barter Island sites are reported on a site-specific basis in Sections 3.0 through 5.0.

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3.0 REMEDIAL INVESTIGATION - NO FURTHER ACTION SITES

This section of the RI/FS presents results from RI sampling and analysis activities for each of the nine Barter Island sites recommended for no further action. The nine sites considered for no further action and discussed in this section are the Old Landfill (LF01), Current Landfill (LF04), Contaminated Ditch (SD08), Old Runway Dump (LF12), Weather Station Building (SS15), POL Tanks (ST17), Fuel Tanks (ST18), Old Dump Site (LF19), and Bladder Diesel Spill (SS20). Each of the no further action sites are presented individually in Sections 3.1 through 3.9. (Note: figures and tables are presented at the end of each section.) The information presented for each site includes site background, field sampling and analytical results, potential migration pathways, human health and ecological risk assessment summaries, and conclusions and recommendations. The site-by-site discussions in this section are intended to provide the reader with all site information needed to support no further action for these sites.

Photographs of the Barter Island installation and the sites investigated during the RI are presented in Appendix B. Data tables in this section list analytical results from samples in which chemicals were detected above quantitation limits. Complete laboratory analytical data sheets for each sample, including quantitation limits for non-detected analytes, are provided in Appendix F.

3.1 OLD LANDFILL (LF01)

3.1.1 Site Background

The Old Landfill (LF01) site is located adjacent to the Beaufort Sea at the northernmost boundary of the Barter Island installation. The landfill was operational between 1956 and 1978 and occupies approximately two to three acres. Historically, the Old Landfill received all wastes generated at the station and the nearby village of Kaktovik. Reportedly it received household waste, human and animal waste, drums, and other maintenance wastes. Station personnel stated that compaction, grading, removal of drums, installation of a gravel cap, and a general cleanup of exposed waste was conducted in 1992. A seawall was constructed on the north end of the landfill in 1992 to prevent erosion of the landfill by coastal wave processes.

Previous sampling, conducted in 1986, 1987, and 1990 by Air Force contractors, detected lead, PCBs, and total petroleum hydrocarbons (TPH) in soil and TPH and VOCs in surface water. A detailed list of source areas, contaminants, and concentrations previously detected is presented in the RI/FS Work Plan (U.S. Air Force 1993a).

The site-specific environmental setting describing the topography, surface water drainage, and soil types is presented in the discussion of potential migration pathways, Section 3.1.3.

3.1.2 Field Sampling and Analytical Results

This section describes the RI sampling and analytical results for samples collected at the Old Landfill (LF01) site. The discussion presents a review of laboratory data, data summary tables, contaminants identified, contaminant trends, and information on suspected source areas.

3.1.2.1 Summary of Samples Collected. A total of 12 samples was collected from gravel pads, ponds, and streams at the site. These consisted of one soil, three sediment and eight surface water samples. Table 2-2 presents a detailed summary of the samples collected and the analyses performed during the 1993 RI field activities. Locations of all samples collected at the Old Landfill (LF01) and a summary of analytical results above background levels are presented in Figure 3-1.

The one soil sample was analyzed for DRPH, RRPH, VOCs, SVOCs, PCBs, TOC, and total metals.

Three sediment samples were analyzed for DRPH, GRPH, RRPH, BTEX, HVOCs, and PCBs. In addition, one sample was analyzed for VOCs and total metals.

Eight surface water samples were analyzed for DRPH and RRPH. In addition, four samples were analyzed for GRPH, BTEX, and PCBs. Two samples were analyzed for VOCs, SVOCs, TOC, TSS, and TDS.

3.1.2.2 Analytical Results. The data summary table (Table 3-1) presents analytical results for all samples collected at the site. Detection and quantitation limits, action levels, associated laboratory and field blanks, and background analytical results are presented for each of the analyses. Background levels are listed to allow direct comparison of naturally occurring organic compounds and inorganic analytes with samples collected from the site. Sample locations and analytical results for the samples at the site are illustrated in Figure 3-1. All organic compounds detected are presented on the figure except when they were a result of laboratory contamination or field decontamination procedures. The exceptions are presented on the data summary table. Only metals detected above background levels are presented on Figure 3-1.

The following section presents a discussion of organic compounds and inorganic analytes detected above background levels at the site. A discussion of TDS, TSS, and TOC is included.

Organics. Organic compounds detected in soil and sediment samples at the site include RRPH and VOCs. RRPH were detected at 530 mg/kg in one sediment sample, LF01-SD03. Five VOCs (1,4-dichlorobenzene; naphthalene; 1,2,4-trichlorobenzene; 1,2,4-trimethylbenzene; and xylenes) were detected in the same sediment sample at very low concentrations ranging from 0.033 to 0.105 mg/kg.

In surface water samples, only two organic compounds were detected. Toluene was detected at 56 μg/L in surface water sample LF01-SW01, and p-isopropyltoluene was detected at 1.7 μg/L in surface water sample LF01-SW03.

In addition, two VOCs were detected in surface water samples at similar concentrations to the field blanks. These compounds, 1,2-dichloroethane and toluene, were detected at concentrations ranging from 2.5 to 3.9 μg/L in the environmental samples and 1.5 to 6.3 μg/L in the field blanks. 1,2-Dichloroethane was also detected in the background samples at concentrations ranging from 1.3 to 3.2 μg/L. These detections are assumed to be the result of field decontamination procedures. The hexane and methanol used in the decontamination procedures may have contained impurities including 1,2-dichloroethane and toluene.

Inorganics. Metals analyses indicated that one metal (lead) was detected at a concentration above background levels in sediment sample LF01-SD01. Lead was detected in this sample at 29 mg/kg.

In surface water samples LF01-SW03 and LF01-SW04, metals analyses detected seven metals (barium, calcium, iron, magnesium, manganese, potassium, and sodium) above background concentrations.

TOC in soil was reported at 820 mg/kg in sample LF01-SD01. TOC in water was reported at 53,900 and 98,000 μg/L in surface water samples LF01-SW03 and LF01-SW04, respectively. TSS were reported at 8,200 and 200,000 μg/L, and TDS were detected at 1,226,000 and 2,416,000 μg/L in the sample respective surface water samples.

3.1.2.3 Summary of Site Contamination. Previous sampling conducted at the Old Landfill (LF01) detected lead, PCBs, and TPH in the soil, and VOCs in surface water at the site. The results and sources of previous sampling efforts are presented in the RI/FS Work Plan (U.S. Air Force 1993a). The quality of the previous IRP sampling data is unknown as is the data validation, if any, that these data have undergone.

Lead, PCBs, and TPH were previously detected in soil samples collected in the drainage pathway bordering the west side of the Old Landfill at 76, 72, and 96 mg/kg, respectively. The sampling was conducted in the same areas as the current RI sampling. Trichloroethane was reported in two previous surface water samples collected from the southwest and north perimeters of the Old Landfill at concentrations of 290 and 110 μg/L, respectively. Six other VOCs were previously detected at low levels ranging from 16 to 0.6 μg/L in samples collected from the landfill perimeter.

During the 1993 RI, low concentrations of RRPH and VOCs were detected, but DRPH, GRPH, and PCBs were not detected in the soils (Table 3-1). Lead in soil was detected at 29 mg/kg. In the surface water samples, two VOCs (toluene and p-isopropyltoluene) were detected at a concentrations of 56 and 1.7 μg/L.

The trend between historical data and current project data indicates the number of organic compounds and the general analytical concentrations are lower now than during previous IRP investigations. The human health and ecological risks associated with the chemicals detected at the site are presented in Sections 3.1.4 and 3.1.5.

The suspected source of contaminants detected during sampling conducted at the Old Landfill is buried garbage and debris from previous waste disposal practices. The landfill has been

inactive for several years, and general cleanup was performed at this location in 1992. This is a possible explanation for the general decrease in contaminants and concentrations detected at the Old Landfill.

3.1.3 Migration Pathways

This section describes the topography and stratigraphy of the site and the migration potential of contaminants from the site. A discussion of receptors and chemical concentrations at receptors is included.

3.1.3.1 Topography and Stratigraphy. The Old Landfill site (LF01) is ringed by surface water bodies. It is bounded to the north by the Beaufort Sea, to the west and east by tundra streams (Figure 3-1). A berm road forms the southern boundary of this site. Noticeable relief is present at the edges of this site in the form of a beach bluff to the north and a deeply incised stream to the west. The beach bluff is approximately 20 feet high and marks the location at which the tundra surface drops down to the beach. The western stream becomes progressively more incised as it passes the site. Near the southern edge this western stream has incised 3 feet into the tundra, and to the north it has incised 12 feet down to the beach. To the southeast of the site is a small pond that feeds a small stream incised approximately two feet into the tundra. The eastern stream retains this incision depth until it reaches the northern beach bluff, where it spills down onto the beach.

During the 1993 RI, permafrost was located at a depth of approximately two and a half feet in tundra areas and four feet under gravel pads. The depth to permafrost is not known at the landfill itself, because soil borings were not conducted there. Gravel pad materials at this site were typical gravels and sands associated with these features. A soil sample collected at the beach revealed well-sorted sands with minor amounts of intermixed gravels, typical of a beach deposit. Subsurface tundra materials were typical of the stratigraphy associated with Barter Island (Section 2.4.4.2).

3.1.3.2 Migration Potential.

Subsurface Migration. The Old Landfill (LF01) is bordered by surface water bodies in all downgradient locations. Although seasonal flow may occur within the site, the surrounding surface water bodies should act as receivers of active layer water from the site. Contaminated active layer water that enters surface water bodies no longer presents a potential for subsurface migration, but a potential for surface migration is created. Consequently, the Old Landfill is expected to have little or no impact upon regional or local active layer water quality.

The western tundra stream is considered the most significant receptor of active layer water from the site. This stream is located immediately adjacent to the landfill, and incision of the stream has created a gradient that may drive active layer water flow. Seeps observed near the base of the landfill suggest that subsurface active layer water flows from the landfill to the western tundra stream. The lack of analytes detected in surface water and sediment samples from a runoff pool located at the base of The Old Landfill (this pool receives water from streams and feeds directly

into the western tundra stream) suggests that the migration potential of this subsurface pathway is limited.

The eastern tundra stream is another potential receptor of affected active layer water. Because this stream is a greater distance from the Old Landfill and there is not a significant gradient, it is considered to be a less significant receptor than the western tundra stream. The eastern tundra stream had a rusty yellow appearance, which is potentially attributable to some leachate drainage into the stream. No leachate streams were identified; however, field investigators noted that the appearance of this stream may have been the result of infiltration from a sewage lagoon located upgradient. No significant contamination was detected in four water samples from this stream.

Surface Migration. Surface water and sediment samples collected from the runoff pool indicate that the western tundra stream is probably not a significant pathway for contaminant migration from the Old Landfill. Surface water and sediment samples collected from the eastern tundra stream indicate that this has been a pathway for the transport of low levels of contaminants.

Four surface water samples were collected from the eastern tundra stream. The presence of low concentrations of toluene in a sample immediately upgradient from the landfill suggests that this compound may be related to an offsite source. Toluene was not detected in other water samples from the site.

Petroleum compounds (DRPH, GRPH, and RRPH) were not detected in water samples and were detected in only one sediment sample (near the mouth of the eastern tundra stream). Because petroleum contamination was not observed by field investigators in the eastern stream and was not detected elsewhere at the site, it is believed that this analytical result is not representative of sediments from the entire stream. This sample may represent a very localized occurrence of RRPH, perhaps attributable to previous waste disposal practices.

Numerous small drainage rills on the landfill's western face indicate that surface water drains into the western stream from the landfill, but such an event is probably restricted to the spring, when an abundant supply of meltwater is available and infiltration is minimal. The presence of seeps in this area demonstrates that subsurface drainage is received from the landfill. Despite the obvious receipt of surface water and active layer water, the lack of any contaminants in surface water and sediments from the western runoff pool indicates that the landfill probably does not significantly affect water quality in this stream.

Air Transport. Air transportation is not believed to be a significant mode of contaminant migration at the site (Section 2.4.4.5).

Summary of Migration Potential. The Old Landfill (LF01) is not believed to have an effect upon the local or regional quality of active layer water because the site is closely bounded by surface water drainage features. Contaminated active layer water that flows offsite will enter surface water bodies. The western tundra stream is considered the most likely surface water body to be affected by the Old Landfill, but analytical results suggest that it is not an active pathway for contaminant migration. Analytical data suggest that relatively low levels of contaminants have migrated in the eastern tundra stream.

3.1.3.3 Receptors and Chemical Concentrations at Receptors.

Human Receptors. Potential human receptors at the Old Landfill site include Air Force contractor personnel working at the station, visitors to the station, and an occasional local visitor passing the site to get to recreational or subsistence lands. Human receptors could potentially be exposed to the chemicals detected in surface water and soils/sediments at the site. The primary routes of potential exposures at the site are direct contact with soils/sediments, incidental ingestion of soils/sediments, and ingestion of surface water. Because groundwater and air at the Barter Island sites are not considered complete pathways of exposure, these media are not evaluated as potential pathways to human receptors.

The Barter Island Risk Assessment (U.S. Air Force 1996) evaluates in detail the risks to human health from all COCs detected at the site. The potential receptor groups were selected based on their likelihood of exposure to contaminants at the site and include DEW Line workers at the installation, and native adults and children who may visit the site. The estimated exposure point concentrations for human receptors are based on the maximum concentration of each chemical detected at the site. The potential risks to human health associated with site chemicals at Barter Island are presented in Section 3.1.4.

Ecological Receptors. Ecological receptors were evaluated in detail in the Barter Island Risk Assessment (U.S. Air Force 1996) to determine if plants and animals could potentially be impacted by the chemicals detected at the Barter Island installation. Because of the diversity of the plants and animals in the area of the Barter Island installation, a set of representative species was selected in the ERA for detailed evaluation. The species include plants, aquatic invertebrates, fish, birds, and mammals. These receptors were selected based on the species' likelihood of exposure given their preferred habitat and feeding habits. The representative species encompass a range of ecological niches in order to achieve the best characterization of the ecosystems being examined and are presented in Table 2-6.

The estimate of chemical concentrations at the ecological receptors was based on the average site-wide concentration of each COC. This approach was appropriate because few of the representative species would inhabit only one distinct site at the installation; they are more likely to be exposed to the mix of chemicals and concentrations detected on all the sites at Barter Island. The potential ecological risks associated with the chemicals detected at the site are presented in Section 3.1.5.

3.1.4 Human Health Risk Assessment

This section presents a summary of the potential human health risks associated with the chemicals detected at the Old Landfill (LF01) site. The purpose of the human health risk assessment is to quantify the excess lifetime cancer risk and/or the noncancer hazard (reported as hazard index) from the chemicals detected at the site.

This summary presents the COCs at the site, the pathways by which human receptors may be exposed to site chemicals, potential risks to human health posed by each chemical through each exposure pathway, the significance of the risk and/or hazard estimate, and a comparison of site

chemical concentrations to ARARs. The methods and assumptions used in calculating hazards and risks are presented in Section 2.4.1.

3.1.4.1 Chemicals of Concern. At the Old Landfill (LF01), no COCs were identified for the soil/sediment matrix. Manganese was determined to be a COC in surface water at the site because the maximum concentration detected exceeded the background concentration and the RBSL.

Table 3-2, Identification of COCs at the Old Landfill, presents the maximum concentrations of chemicals detected at the site, the associated background concentrations, RBSLs, and ARARs, and identifies the COC selected in the risk evaluation.

3.1.4.2 Exposure Pathways and Potential Receptors. Because no COCs were identified for soil/sediment at the Old Landfill site, only ingestion of surface water was evaluated in the risk assessment.

Three potential receptor groups were evaluated in the risk assessment: an adult assigned to a DEW Line installation (worker), an adult inhabitant of communities in the North Slope of Alaska (native), and a child living in a North Slope community (child).

3.1.4.3 Risk Characterization.

Noncancer Hazard and Cancer Risk Asso**ciated with Soils and Sediments**. No COCs were identified for the soil at the Old Landfill (LF01). The concentrations measured were below those considered acceptable under EPA Region 10 guidance (EPA 1991a) or ARARs.

Noncancer Hazard and Cancer Risk Associated with Surface Water. The noncancer hazard associated with ingestion of surface water at the site by a hypothetical native northern adult or a DEW Line worker is 4.2, based on the maximum concentration of the COC. The presence of manganese in surface water accounts entirely for the quantifiable noncancer hazard for this receptor/pathway combination. Manganese was the only chemical detected in surface water at the site that exceeded an RBSL or ARAR.

3.1.4.4 Summary of Human Health Risk Assessment. The only risk or hazard associated with the Old Landfill site is the noncancer hazard index of 4.2 associated with the maximum concentration of manganese detected in surface water. The noncancer hazard for manganese in surface water was calculated assuming the affected surface water would be used as a sole-source water supply for 180 days per year. Based on site-specific information, the manganese in surface water does not currently pose a health hazard nor is it likely to pose a hazard in the future. The surface water expressions at the site are frozen most of the year; many are only intermittently filled with water during the summer months. The surface water at the site is not used for a water supply now, nor has it been used in the past. In conclusion, under current uses the COC identified in surface water at the Old Landfill site poses only a minimal, if any, potential threat to human health. Based on the human health risk assessment, remedial actions are not warranted at the site. In the unlikely event that surface water at the site is used

as a sole-source drinking water supply in the future, a potential noncancer hazard to human health could exist if current conditions remain constant.

3.1.5 Ecological Risk Assessment

The objective of the ERA is to estimate the potential impacts of chemicals detected at the installation to aquatic and terrestrial plants and animals. A summary of the methods used to assess potential ecological impacts is presented in Section 2.4.2.

3.1.5.1 Chemicals of Concern. COCs were selected based on criteria presented in Section 3.1 of the ERA. The average installation-wide concentrations of COCs were used to calculate the risk estimates. Aluminum, iron, and manganese were identified as COCs in surface water, while the COCs detected in soils/sediments at the Old Landfill were naphthalene, lead, and zinc. Iron and manganese in surface water were associated with elevated HQs, while none of the soil/sediment COCs were associated with elevated risk estimates at the site.

3.1.5.2 Exposure Pathways and Potential Receptors. Potential exposure pathways for terrestrial and aquatic organisms include direct contact with, and ingestion of, contaminated soil/sediment and/or surface water. The most significant route of exposure for plants is direct contact with soil. Aquatic organisms such as fish and invertebrates are primarily exposed through direct contact with surface water, and average surface water concentrations were used to evaluate potential exposures. They may also be exposed to COCs through ingestion of plant and animal items in their diet, and incidental ingestion of soil/sediment while foraging, although these pathways are considered less significant and are not used to calculate HQs. Birds and mammals may be exposed to COCs through ingestion of surface water, ingestion of plant and animal diet items (although only ingestion of plant matter was quantified in the estimated exposure equations, and incidental ingestion of soil/sediment.

The potential ecological receptors evaluated in the risk assessment include plants, aquatic organisms, birds, and mammals likely to occur along the Arctic Coastal Plain. Representative species from these receptor groups were selected based primarily on the species' likelihood of exposure, preferred habitat, and feeding habits. Species that may be particularly sensitive to environmental impacts, such as threatened and endangered species, are considered on an individual basis if present at or near the installation. Spectacled and Steller's eiders have been identified in the vicinity of the Barter Island installation, although there is a low probability that either species is currently nesting or raising broods on the Barter Island sites (Alaska Biological Research 1994). The ERA evaluation included the spectacled eider, and this evaluation was also used to evaluate any potential risk to Steller's eiders should they be found at the installation. The species evaluated in the ERA are listed in Table 2-6.

3.1.5.3 Risk Characterization. Potential risks to arctic char, nine-spined stickleback, and *Daphnia* ssp. at the Old Landfill site were attributed to iron and manganese in surface water. The iron HQs were nine for three species, and the manganese HQs were eight for the char and stickleback and three for Daphnia. No potential risks were associated with the COCs detected in soil/sediment at the Old Landfill.

3.1.5.4 Summary of Ecological Risk Assessment. Although the HQs are elevated for iron and manganese in surface water, the essential nutrient status, uncertainty associated with the toxicity references values for these metals, and the relatively low HQs indicate that the risk from these two metals in surface water is likely to be inconsequential. The impact to aquatic receptors is likely to be the result of dissolved concentrations, which are lower than the total concentrations for both of these metals.

The ERA indicates that, although there are a few instances of potential risk to individual species, overall the potential risks presented by the chemicals detected at the site are low.

3.1.6 Conclusions and Recommendations

Sampling and analyses have determined that the Old Landfill (LF01) site is not significantly contaminated. Only relatively low levels of contaminants were detected at the site, and metals slightly above background concentrations were the only COCs identified at the site. Migration of contaminants from the site appears minimal based on the surface water samples collected in drainage pathways on three sides of the landfill.

The risk assessment concluded that risks posed to human health and ecological receptors by site contaminants are minimal given current or future site uses. A potential noncancer hazard was identified in surface water from manganese. This potential human health hazard is based on a future scenario in which the site surface water would be used as a sole drinking water supply and is likely overestimated. The ERA concluded that the overall potential ecological risks presented by site contaminants are minimal. Therefore, considering the findings of the risk assessment, remediation of the site is not necessarily warranted.

Based on the RI sampling and analyses, risk assessment, and current site uses, remedial actions are not warranted at the site. No chemicals detected at the site exceed ARARs, and no significant human health or ecological risks were identified at the site. Therefore, the Old Landfill (LF01) site is recommended for no further action.

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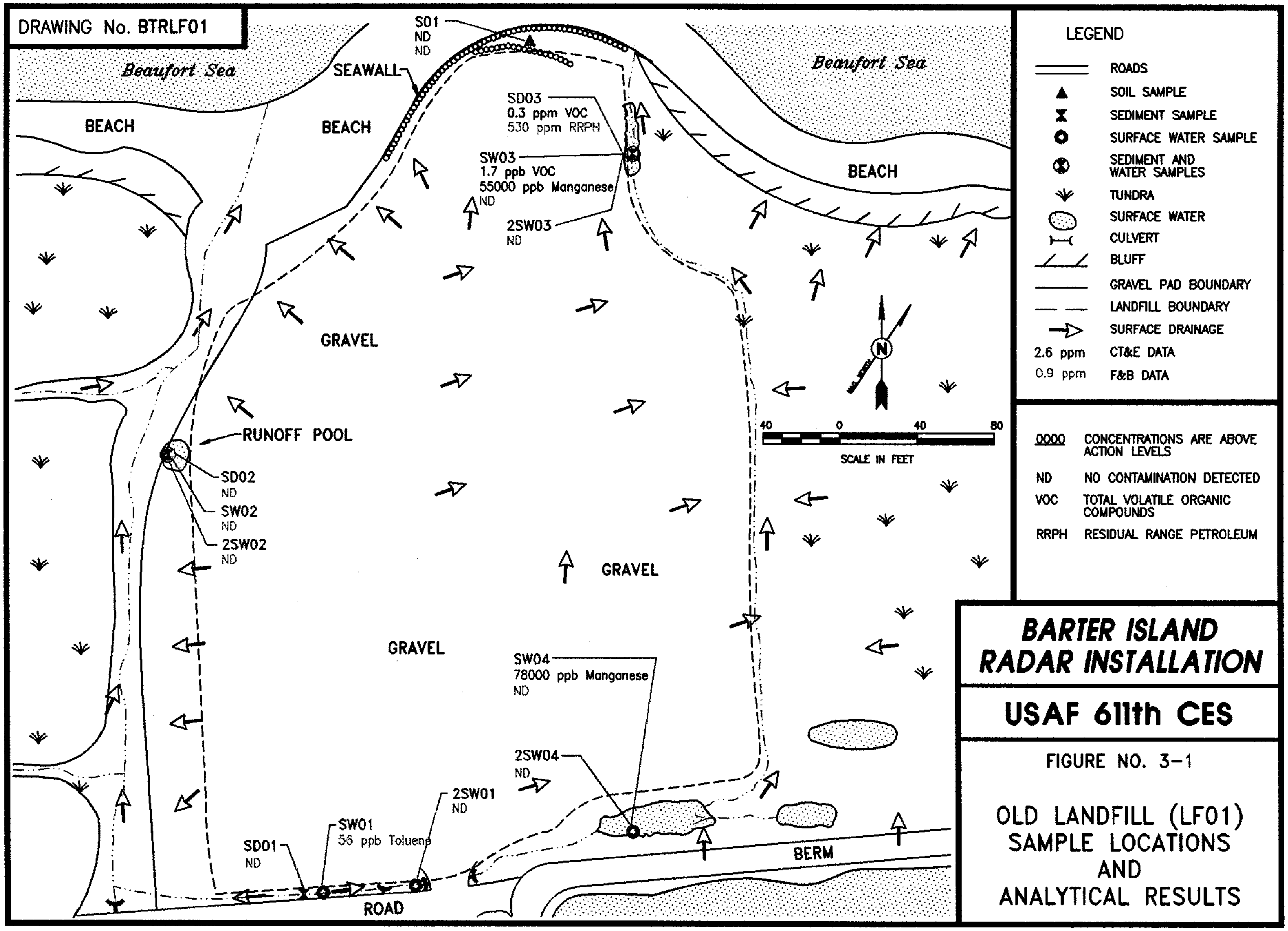
DRAWING No. BTRLF01
Beaufort Sea
SEAWALL
BEACH
BEACH
S01
ND
ND
SD03
0.3 ppm VOC
530 ppm RRPH
SW03
1.7 ppb VOC
55000 ppb Manganese
ND
2SW03
ND
Beaufort Sea
BEACH
GRAVEL
RUNOFF POOL
SD02
ND
SW02
ND
2SW02
ND
GRAVEL
GRAVEL
SW04
78000 ppb Manganese
ND
2SW04
ND
2SW01
ND
SW01
56 ppb Toluene
SD01
ND
ROAD
BERM
40 0 40 80
SCALE IN FEET
N
LEGEND
ROADS
SOIL SAMPLE
SEDIMENT SAMPLE
SURFACE WATER SAMPLE
SEDIMENT AND WATER SAMPLES
TUNDRA
SURFACE WATER
CULVERT
BLUFF
GRAVEL PAD BOUNDARY
LANDFILL BOUNDARY
SURFACE DRAINAGE
2.6 ppm CT&E DATA
0.9 ppm F&B DATA
0000 CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND NO CONTAMINATION DETECTED
VOC TOTAL VOLATILE ORGANIC COMPOUNDS
RRPH RESIDUAL RANGE PETROLEUM
BARTER ISLAND RADAR INSTALLATION
USAF 611th CES
FIGURE NO. 3-1
OLD LANDFILL (LF01) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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TABLE 3-1. OLD LANDFILL ANALYTICAL DATA SUMMARY

Installation: Barter Island
Site: Old Landfill (LF01)
Matrix: Soil/Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks					Lab Blanks	
					S01	SD01	SD02	SD03	AB02	EB04	EB05	TB04	TB05		
Laboratory Sample ID Numbers					322 4303-2	1340	1342	1344 4286-5	315 4303-1	311 4302-10	332 392 4303-5	1346 4302-9	375	#3&4-82493 #3&4-83193 #1&2-82493 4302/4303	#6-82493 #6-83193 #1&2-83193 4303
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-11	50-110	500[a]	9.55-1,150	<50R[b]	<50[b]	<110[b]	<110J[b]	NA	NA	<1,000[b]	NA	NA	NA	<70J
GRPH	0.2-0.4	2-4	100	<0.4-<9	NA	<2J[b]	<4J[b]	<4J[b]	<100J[b]	<100J[b]	<100J[b]	<100J[b]	<50J	<50J-<100J	<2J
RRPH (Approx.)	10-22	100-220	2,000[a]	<480	<100	<110	<220	530	NA	NA	<1,000	NA	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	NA	<0.10	<0.20	<0.20							
Benzene	0.002-0.004	0.02-0.04	0.5	<0.020-<0.300	NA	<0.02	<0.04	<0.04	<1	<1	<1	<1	<1	<1	<0.02
Toluene	0.002-0.004	0.02-0.04		<0.020-<0.300	NA	<0.02	<0.04	<0.04	<1	<1	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002-0.004	0.02-0.04		<0.020-<0.300	NA	<0.02	<0.04	<0.04	<1	<1	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004-0.008	0.04-0.08		<0.040-<0.600	NA	<0.04	<0.08	<0.08	<2	<2	<2	<2	<2	<2	<0.04
HVOC (8010 Mod.)	0.002-0.004	0.02-0.04		<0.5J	NA	<0.02J	<0.04J	<0.04J	<1	<1	<1	<1J	<1	<1J	NA
VOC 8260															
1,4-Dichloro-benzene	0.020	0.025-0.030		<0.025-<0.500	<0.025J	NA	NA	0.044	<1	<1	<1	<1	NA	<1	<0.020
Naphthalene	0.020	0.025-0.030		<0.025-<0.500	<0.025J	NA	NA	0.105	<1	<1	<1	<1	NA	<1	<0.020
1,2,4-Trichloro-benzene	0.020	0.025-0.030		<0.025-<0.500	<0.025J	NA	NA	0.046	<1	<1	<1	<1	NA	<1	<0.020
1,2,4-Trimethyl-benzene	0.020	0.025-0.030		<0.025-<0.500	<0.025J	NA	NA	0.041	<1	<1	<1	<1	NA	<1	<0.020
Xylenes (Total)	0.040	0.050-0.060		<0.050-<1.000	<0.050J	NA	NA	0.033[c]	<2	<2	<2	<2	NA	<2	<0.020

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
R Result has been rejected.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c Result is indicative of p & m xylenes only.

TABLE 3-1. OLD LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Old Landfill (LF01)

Matrix: Soil/Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks					Lab Blanks	
					S01	SD01	SD02	SD03	AB02	EB04	EB05	TB04	TB05		
Laboratory Sample ID Numbers					322 4303-2	1340	1342	1344 4286-5	315 4303-1	311 4302-10	332 392 4303-5	1346 4302-9	375	#5-82493 4302/4303	#6-82393 4303
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/kg
SVOC 8270	0.200	0.230		<0.23-<3.5	<0.230R	NA	NA	NA	NA	<25-75	<11	NA	NA	<10	<0.200
PCBs	0.01	0.1	10	<0.020-<0.100	<0.5R	<0.1	<0.1	<0.1	NA	NA	<10	NA	NA	NA	<0.1-<0.5
TOC				32,000-199,000	820	NA	NA	NA	NA	<5,000	<5,000J	NA	NA	<5,000	NA

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
R Result has been rejected.

TABLE 3-1. OLD LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Old Landfill (LF01)

Matrix: Soil/Sediment
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples					Field Blanks			Lab Blanks
					S01	SD03				EB04	EB05		
Laboratory Sample ID Numbers					4303-2	4286-5				4302-10	4303-5		4286 4302
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg				μg/L	μg/L		μg/L
Aluminum	0.35	2		1,500-25,000	1,900	3,600				<100	<100		<100
Antimony	N/A	56-64		<7.8-<230	<56	<64				<100	<100		<100
Arsenic	0.11	5.6-6.4		<4.9-8.5	<5.6	<6.4				<100	<100		<100
Barium	0.024	1		27-390	19	76				<50	<50		<50
Beryllium	N/A	2.8-3.2		<2.6-6.4	<2.8	<3.2				<50	<50		<50
Cadmium	0.33	2.8-3.2		<3.0-<36	<2.8	<3.2				<50	<50		<50
Calcium	0.69	4		360-59,000	4,650	10,600				<200	<200		<200
Chromium	0.066	1		<4.3-47	4.1	6.6				<50	<50		<50
Cobalt	N/A	5.6-6.4		<5.1-12	<5.6	<6.4				<100	<100		<100
Copper	0.045	1		<2.7-45	3.3	14				<50	<50		<50
Iron	0.50	2		5,400-35,000	5,000	12,000				<100	200		<100
Lead	0.13	2-5.6		<5.1-22	<5.6	29				<100	<100		<100
Magnesium	0.96	4		360-7,400	990	2,700				<200	<200		<200
Manganese	0.025	1		25-290	52	170				<50	<50		<50
Molybdenum	N/A	2.8-3.2		<2.5-<11	<2.8	<3.2				<50	<50		<50
Nickel	0.11	1		4.2-46	4.3	8.6				<50	<50		<50
Potassium	23	100-280		<300-2,200	<280	610				<5,000	<5,000		<5,000
Selenium	1.2	5.6-64		<7.8-<170	<5.6	<64				<100	<100		<100

☐ CT&E Data.
N/A Not analyzed.

TABLE 3-1. OLD LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Old Landfill (LF01)

Matrix: Soil/Sediment
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples					Field Blanks			Lab Blanks
					S01	SD03				EB04	EB05		
Laboratory Sample ID Numbers					4303-2	4286-5				4302-10	4303-5		4286 4302
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg				µg/L	µg/L		µg/L
Silver	0.53	2.8-3.2		<3-<110	<2.8	<3.2				<50	<50		<50
Sodium	0.55	5		<160-680	78	160				<250	<250		<250-267
Thallium	0.011	0.27-0.28		<0.2-<1.2	<0.27	<0.28				<5	<5		<5
Vanadium	0.036	1		6.3-59	4.9	11				<50	<50		<50
Zinc	0.16	1		9.2-95	12	55				<50	<50		<50

☐ CT&E Data.

TABLE 3-1. OLD LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Old Landfill (LF01)
Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples: SW01	SW02	SW03	SW04	Field Blanks: AB02	EB04	EB05	TB04	Lab Blanks
Laboratory Sample ID Numbers					1372 1374	1368 1370	1362 1364 4285-2	1348 1354 4285-1	315 4303-1	311 4302-10	332 392 4303-5	1346 4302-9	#3&4-83193 #3&4-82493 4285 4302/4303
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
DRPH	100	1,000		<200	<1,000R[b]	<1,000[b]	<1,000[b]	<1,000[b]	NA	NA	<1,000[b]	NA	NA
GRPH	10	100		<20	<100J[b]	<100J[b]	<100J[b]	<100J[b]	<100J[b]	<100J[b]	<100J[b]	<100J[b]	<100J
RRPH (Approx.)	200	2,000		NA	<2,000	<2,000	<2,000	<2,000	NA	NA	<1,000	NA	NA
BTEX (8020/8020 Mod.)													
Benzene	0.1	1	5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	0.1	1	1,000	<1	56	<1	<1	<1	<1	<1	<1	<1	<1
Ethyl-benzene	0.1	1	700	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Xylenes (Total)	0.2	2	10,000	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
HVOC 8010	0.1	1		<0.5J	<1	<1	<1	<1	<1	<1	<1	<1J	<1J
VOC 8260													
1,2-Dichloroethane	1	1	5	3U-3.2B	NA	NA	3.9B	3.9B	6.3	1.5	3.2	<1	<1
p-Isopropyltoluene	1	1		<1	NA	NA	1.7	<1	<1	<1	<1	<1	<1
Toluene	1	1	1,000	<1	NA	NA	<1	2.5B	2.2	2.3	2.3	<1	<1
SVOC 8270	10	20-22		<10	NA	NA	<22	<20	NA	<25-75	<11	NA	<10

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
J Result is an estimate.
R Result has been rejected.
U Compound is not present above the concentration listed.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE 3-1. OLD LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Old Landfill (LF01)

Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks				Lab Blanks
					SW01	SW02	SW03	SW04	AB02	EB04	EB05	TB04	
Laboratory Sample ID Numbers					1372 1374	1368 1370	1362 1364 4285-2	1348 1354 4285-1	315 4303-1	311 4302-10	332 392 4303-5	1346 4302-9	4285 4302 4303
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
PCBs	0.2	2	0.5	<1	<2R	<2J	<2	<2J	NA	NA	<10	NA	NA
TOC	5,000	5,000		<5,000-12,000	NA	NA	53,900J	98,000	NA	<5,000	<5,000J	NA	<5,000
TSS	100	100		<30,000-8,000	NA	NA	8,200	200,000	NA	NA	NA	NA	<100
TDS	10,000	10,000		<352,000-328,000	NA	NA	1,226,000J	2,416,000	NA	NA	NA	NA	<10,000

□ CT&E Data.
■ F&B Data.
NA Not analyzed.
J Result is an estimate.
R Result has been rejected.

TABLE 3-1. OLD LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Old Landfill (LF01)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples						Field Blank			Lab Blanks
					SW03	SW04						EB04		
Laboratory Sample ID Numbers					4285-2	4285-1						4302-10		4285 4302
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L						µg/L		µg/L
Aluminum	17.4	100		<100-350 (<100-340)	180 (<100)	<100 (<100)						<100		<100 (<100)
Antimony	N/A	50	6	<100 (<100)	<100 (<100)	<100 (<100)						<100		<100 (<100)
Arsenic	5.3	50	50	<100 (<100)	<100 (<100)	<100 (<100)						<100		<100 (<100)
Barium	1.2	50	2,000	<50-93 (<50-91)	120 (89)	120 (110)						<50		<50 (<50)
Beryllium	N/A	50	4	<50 (<50)	<50 (<50)	<50 (<50)						<50		<50 (<50)
Cadmium	1.7	50	5	<50 (<50)	<50 (<50)	<50 (<50)						<50		<50 (<50)
Calcium	34.5	200		4,500-88,000 (4,100-86,000)	130,000 (130,000)	190,000 (180,000)						<200		<200-378 (378)
Chromium	3.29	50	100	<50 (<50)	<50 (<50)	<50 (<50)						<50		<50 (<50)
Cobalt	N/A	100		<100 (<100)	<100 (<100)	<100 (<100)						<100		<100 (<100)
Copper	2.3	50	1,300	<50 (<50)	<50 (<50)	<50 (<50)						<50		<50 (<50)
Iron	25	200		180-2,800 (<100-1,600)	15,000 (240)	3,200 (340)						<100		<100 (<100)
Lead	6.6	100	15	<100 (<100)	<100 (<100)	<100 (<100)						<100		<100 (<100)

☐ CT&E Data.
N/A Not analyzed.

TABLE 3-1. OLD LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Old Landfill (LF01)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples						Field Blank			Lab Blanks
					SW03	SW04						EB04		
Laboratory Sample ID Numbers					4285-2	4285-1						4302-10		4285 4302
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L						µg/L		µg/L
Magnesium	47.8	50		<5,000-53,000 (2,600-54,000)	55,000 (54,000)	78,000 (76,000)						<200		<200 (<200)
Manganese	1.24	50		<50-510 (<50-120)	1,500 (1,400)	560 (480)						<50		<50 (<50)
Molybdenum	N/A	50		<50 (<50)	<50 (<50)	<50 (<50)						<50		<50 (<50)
Nickel	5.5	50	100	<50 (<50)	<50 (<50)	<50 (<50)						<50		<50 (<50)
Potassium	1,154	5,000		<5,000 (<5,000)	9,400 (9,100)	110,000 (101,000)						<5,000		<5,000 (<5,000)
Selenium	62.4	100	50	<100 (<100)	<100 (<100)	<100 (<100)						<100		<100 (<100)
Silver	2.6	50	50	<50 (<50)	<50 (<50)	<50 (<50)						<50		<50 (<50)
Sodium	27.7	250		8,400-410,000 (8,200-450,000)	160,000 (150,000)	440,000 (410,000)						<250		<250-267 (<250)
Thallium	0.57	5	2	<5 (<5)	<5 (<5)	<5 (<5)						<5		<5 (<5)
Vanadium	1.8	50		<50 (<50)	<50 (<50)	<50 (<50)						<50		<50 (<50)
Zinc	8.2	50		<50-160 (<50)	<50 (<50)	<50 (<50)						<50		<50 (<50)

☐ CT&E Data.
N/A Not analyzed.

TABLE 3-1. OLD LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island   Matrix: Surface Water
Site: Old Landfill (LF01)   Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples							Field Blank			Lab Blank
					2SW01	2SW02	2SW03	2SW04					EB06		
Laboratory Sample ID Numbers					1663	1664	1665	1666					1688 1690		#5-9693
ANALYSES	µg/L	µg/L		µg/L	µg/L	µg/L	µg/L	µg/L					µg/L		µg/L
DRPH	100	1,000		<200	<1,000[b]	<1,000[b]	<1,000[b]	<1,000[b]					<1,000J[b]		<1,000J
RRPH (Approx.)	200	2,000		NA	<2,000	<2,000	<2,000	<2,000					<2,000		<2,000

☐ CT&E Data.
▓ F&B Data.
NA Not analyzed.
J Result is an estimate.
b DRPH concentrations reported for these samples are equivalent to diesel range organics (DRO) as defined by ADEC.

TABLE 3-2. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE OLD LANDFILL (LF01)

SITE	MATRIX	CHEMICAL DETECTED[a]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[b]		ARAR[c]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Old Landfill (LF01)	Soil	RRPH	530	mg/kg	<480	--	--	2,000[d]	NO
		1,4-Dichlorobenzene	0.044	mg/kg	<0.020-<0.500	2.67	--	--	NO
		Naphthalene	0.105	mg/kg	<0.025-<3.50	--	1,100	--	NO
		1,2,4-Trichlorobenzene	0.046	mg/kg	<0.025-<0.500	--	270	--	NO
		1,2,4-Trimethylbenzene	0.041	mg/kg	<0.025-<0.500	--	--	--	NO
		Xylenes	0.033	mg/kg	<0.040-<1.000	--	54,000	--	NO
		Aluminum	3,600	mg/kg	1,500-25,000	--	--	--	NO
		Barium	76	mg/kg	27-390	--	1,890	--	NO
		Calcium	10,600	mg/kg	360-59,000	--	--	--	NO
		Chromium	6.6	mg/kg	<4.3-47	--	135	--	NO
		Copper	14	mg/kg	<2.7-45	--	999	--	NO
		Iron	12,000	mg/kg	5,400-35,000	--	--	--	NO
		Lead	29	mg/kg	<5.1-22	--	--	500[e]	NO
		Magnesium	2,700	mg/kg	360-7,400	--	--	--	NO
		Manganese	170	mg/kg	25-290	--	3,780	--	NO
		Nickel	8.6	mg/kg	4.2-46	--	540	--	NO
		Potassium	610	mg/kg	<300-2,200	--	--	--	NO
		Sodium	160	mg/kg	<160-680	--	--	--	NO

a The concentrations reported for metals in surface water are total metals.
b Risk-Based Screening Level.
c Applicable or Relevant and Appropriate Requirement.
d ADEC 1991.
e EPA 1989d.
f MCL, 56 FR 3526 (30 January 1991).
g MCL, 56 FR 30266 (01 July 1991).

TABLE 3-2. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE OLD LANDFILL (LF01) (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED[a]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[b]		ARAR[c]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Old Landfill	Soil	Vanadium	11	mg/kg	6.3-59	--	189	--	NO
(LF01)	(Continued)	Zinc	55	mg/kg	9.2-95	--	8,100	--	NO
(Continued)	Water	p-Isopropyltoluene	1.7	µg/L	<1	--	--	--	NO
		Toluene	56	µg/L	<1	--	96.5	1,000[f]	NO
		Aluminum	180	µg/L	<100-350	--	--	--	NO
		Barium	120	µg/L	<50-93	--	256	2,000[g]	NO
		Calcium	190,000	µg/L	4,100-88,000	--	--	--	NO
		Iron	15,000	µg/L	<100-2,800	--	--	--	NO
		Magnesium	78,000	µg/L	<5,000-54,000	--	--	--	NO
		Manganese	1,500	µg/L	<50-510	--	18.3	--	YES
		Potassium	110,000	µg/L	<5,000	--	--	--	NO
		Sodium	440,000	µg/L	8,400-450,000	--	--	--	NO

a The concentrations reported for metals in surface water are total metals.
b Risk-Based Screening Level.
c Applicable or Relevant and Appropriate Requirement.
d ADEC 1991.
e EPA 1989d.
f MCL, 56 FR 3526 (30 January 1991).
g MCL, 56 FR 30266 (01 July 1991).

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3.2 CURRENT LANDFILL (LF04)

3.2.1 Site Background

The Current Landfill site (LF04) is located northwest of the module trains, and southwest of the Old Landfill (LF01). The Current Landfill is approximately two acres in size and receives wastes generated by the installation. It received waste from the nearby village of Kaktovik from 1978 to 1992 while the village constructed its own landfill; the use of the site by Kaktovik community residents was uncontrolled. It reportedly received household waste, human and animal waste, drums, and other maintenance wastes. Currently the disposal of wastes at this site by station personnel is in accordance with appropriate regulations.

Previous sampling, conducted in 1986, 1987, and 1990 by Air Force contractors, detected petroleum compounds, solvents, and PCBs in surface water and lead in soil. A detailed list of source areas, contaminants, and concentrations previously detected is presented in the RI/FS Work Plan (U.S. Air Force 1993a).

The site-specific environmental setting describing the topography, surface water drainage, and soil types is presented in the discussion of potential migration pathways, Section 3.2.3.

3.2.2 Field Sampling and Analytical Results

This section describes the RI sampling and analytical results for samples collected at the Current Landfill (LF04) site. The discussion presents a review of laboratory data, data summary tables, contaminants identified, contaminant trends, and information on suspected source areas.

3.2.2.1 Summary of Samples Collected. A total of 11 samples was collected from tundra and streams at the site. These consisted of two soil, four sediment, and five surface water samples. Table 2-2 presents a detailed summary of the samples collected and the analyses performed during the 1993 RI field activities. Locations of all samples collected at the Current Landfill (LF04) site and a summary of analytical results above background levels are presented in Figure 3-2.

Two soil samples were analyzed for DRPH, GRPH, RRPH, BTEX, HVOC, and PCBs.

Four sediment samples were analyzed for DRPH, GRPH, RRPH, BTEX, HVOCs, and VOCs. In addition, two samples were analyzed for PCBs, SVOCs, TOC, and total metals.

Five surface water samples were analyzed for DRPH and RRPH. In addition, three samples were analyzed for GRPH, BTEX, HVOCs, and VOCs. Two samples were analyzed for PCBs, SVOCs, TOC, TSS, TDS, and total and dissolved metals.

3.2.2.2 Analytical Results. The data summary table (Table 3-2) presents analytical results for all samples collected at the site. Detection and quantitation limits, action levels, the associated laboratory and field blanks, and background analytical results are listed for each of the analyses. Background levels are listed to allow direct comparison of naturally occurring

organic compounds and inorganic analytes with samples collected from the site. Sample locations and analytical results for the samples at the site are illustrated in Figure 3-2. All organic compounds detected are presented on the figure except when they were a result of laboratory contamination or field decontamination procedures. The exceptions are presented on the data summary table. Only metals detected above background levels are presented on Figure 3-2.

The following section presents a discussion of organic compounds and inorganic analytes detected above background levels at the site. A discussion of TDS, TSS, and TOC is included.

Organics. Organic compounds detected in soil and sediment samples collected at the site include DRPH, GRPH, and BTEX compounds. DRPH were detected in one sample, LF04-SD02, at 60 mg/kg. GRPH were detected in one sample, LF04-2SD04, at 8 mg/kg. Toluene and xylene were detected at 0.026 and 0.2 mg/kg, respectively.

In surface water samples, organic compounds detected were limited to three VOCs in one sample, LF04-SW02. Trichloroethane was detected at 36 μg/L, and two other VOCs were detected at low concentrations of 1.1 and 3.7 μg/L.

In addition, two VOCs were detected in surface water samples at similar concentrations to the field blanks. These compounds, 1,2-dichloroethane and toluene, were detected at concentrations ranging from 1.1 to 2.7 μg/L in the environmental samples and 1.5 to 6.3 μg/L in the field blanks. 1,2-Dichloroethane was also detected in the background samples at concentrations ranging from 1.3 to 3.2 μg/L. These detections are assumed to be the result of field decontamination procedures. The hexane and methanol used in the decontamination procedures may have contained impurities including 1,2-dichloroethane and toluene.

Inorganics. No metals were detected above background concentrations in soil or sediment samples at the site. In surface water samples, metals analyses detected five metals (barium, calcium, iron, manganese, and potassium) above background concentrations.

TOC was reported at 198,000 and 2,860 mg/kg in sediment samples LF04-SD01 and LF04-SD02, respectively. In surface water samples, TOC were reported at 23,400 and 26,600 μg/L in LF04-SW01 and LF04-SW02, respectively. TSS were reported at 156,000 and 22,000 μg/L, and TDS were reported at 905,000 and 614,000 μg/L in surface water samples LF04-SW01 and LF04-SW02, respectively.

3.2.2.3 Summary of Site Contamination. Previous sampling conducted at the Current Landfill (LF04) detected TPH, BTEX, and VOCs in surface water and lead in soil. The results and the sources of previous sampling efforts are presented in the RI/FS Work Plan (U.S. Air Force 1993a). The quality of the previous IRP sampling data is unknown as is the data validation, if any, that these data have undergone.

During previous sampling conducted in 1986, 1987, and 1990, lead was detected in a soil sample at a concentration of 52 mg/kg. No organic compounds were detected in soil samples during previous sampling efforts. TPH was detected in a previous surface water sample at 300 μg/L. Total BTEX was reported in two previous surface water samples at concentrations of 37 and

101.2 µ/L, and four other VOCs were detected at concentrations ranging from 1.1 to 18 µg/L; trichloroethane was the primary component (18 µg/L).

A comparison of historical data and current project data indicates a decrease in the concentration of petroleum compounds and VOCs in soils and surface water at the site. During the 1993 RI, low levels of petroleum compounds were detected in soil/sediment samples collected at the site (Table 3-2). Lead was detected in sediment samples below background levels. Trichloroethane was detected in surface water sample LF04-SW02 at 36 µg/L. Two other VOCs were detected at low concentrations in two surface water samples at 1.1 and 6 µg/L. The human health and ecological risks associated with the chemicals detected at the site are presented in Sections 3.2.4 and 3.2.5.

The suspected source of contaminants detected during sampling conducted at the Current Landfill is previous waste disposal at the Current Landfill and/or areas to the north of the Landfill. Hundreds of drums of wastes, "honey buckets", from the village of Kaktovik were stored on the north end of the landfill gravel pad. Spills and/or leaks from these drums may have contributed to the contaminants detected in the drainage pathway just north of the active landfill area.

3.2.3 Migration Pathways

This section describes the topography and stratigraphy of the site and the migration potential of contaminants from the site. A discussion of receptors and chemical concentrations at receptors is included.

3.2.3.1 Topography and Stratigraphy. The Current Landfill (LF04) site consists of a gravel pad placed upon the tundra (Figure 3-2). This gravel pad is approximately 3-1/2 feet high. A tundra stream flows along the eastern side; this stream passes through a culvert under the road and continues on past the Old Landfill (LF01). A tributary of the previously mentioned tundra stream flows along the western and northern edges of the site. This is a small stream that remains relatively unincised until it approaches the larger tundra stream, where it incises to approximately six feet. The Current Landfill is surrounded by relatively flat tundra on all sides.

During the 1993 RI, permafrost was located at a depth of approximately two and a half feet in tundra areas and four feet under gravel pads. The depth to permafrost is not known at the landfill itself, because soil borings were not conducted there. Gravel pad materials at the site were typical gravels and sands associated with these features, and subsurface tundra materials were typical of the stratigraphy found at Barter Island (Section 2.4.4.2).

3.2.3.2 Migration Potential.

Subsurface Migration. Subsurface migration may occur at the site but is limited because of the proximity of downgradient streams. Although seasonal flow may occur within the site, the downgradient streams should act as receivers of active layer water, preventing the flow of active layer water beyond the site. Contaminated active layer water that enters the streams no longer presents a potential for subsurface migration, but a potential for surface migration is created.

The relatively flat topography (which provides only a small gradient to drive subsurface drainage) indicates the subsurface drainage is limited.

Surface Migration. Surface migration at the site is controlled by the tundra stream and its tributary. Analytical data suggest that the main tundra stream (which flows past the eastern edge of the site) is not a significant migration pathway. No organic compounds were detected in upgradient sediment or surface water samples from this stream that were not also detected in the associated blanks and background samples. Low levels of VOCs were detected downgradient in a sediment and surface water sample.

Analytical data suggest the tributary stream to the north of the Current Landfill is a migration pathway. Although the only analyte detected in a sediment sample collected 150 feet upstream from the tributary mouth was gasoline (at 8 mg/kg), surface water and sediment samples collected 30 feet upstream of the mouth contained low VOC and/or DRPH concentrations. The source of these compounds may be previous uncontrolled waste disposal.

Air Transport. Air transportation is not considered to be a significant mode of migration at the site (Section 2.4.4.5).

Summary of Migration Potential. Streams at the site limit the distance that contaminated active layer water can travel. These streams act as receptors for the active layer water and are the primary migration pathways at the site. Analytical data suggest that the tributary stream may have transported relatively low amounts of DRPH and VOCs. The main tundra stream does not appear to be a significant migration pathway.

3.2.3.3 Receptors and Chemical Concentrations at Receptors.

Human Receptors. Potential human receptors at the Current Landfill site include Air Force contractor personnel working at the station, visitors to the station, and an occasional local visitor passing the site to get to recreational or subsistence lands. Human receptors could potentially be exposed to the chemicals detected in surface water and soils/sediments at the site. The primary routes of potential exposures at the site are direct contact with soils/sediments, incidental ingestion of soils/sediments, and ingestion of surface water. Because groundwater and air at the Barter Island sites are not considered complete pathways of exposure, these media are not evaluated as potential pathways to human receptors.

The Barter Island Risk Assessment (U.S. Air Force 1996) evaluates in detail the risks to human health from all COCs detected at the site. The potential receptor groups were selected based on their likelihood of exposure to contaminants at the site, and include DEW Line workers at the installation, and native adults and children who may visit the site. The estimated exposure point concentrations for human receptors are based on the maximum concentration of each chemical detected at the site. The potential risks to human health associated with site chemicals at Barter Island are presented in Section 3.1.4.

Ecological Receptors. Ecological receptors were evaluated in detail in the Barter Island Risk Assessment (U.S. Air Force 1996) to determine if plants and animals could potentially be

impacted by the chemicals detected at the Barter Island installation. Because of the diversity of the plants and animals in the area of the Barter Island installation, a set of representative species was selected in the ERA for detailed evaluation. The species include plants, aquatic invertebrates, fish, birds, and mammals. These receptors were selected based on the species' likelihood of exposure given their preferred habitat and feeding habits. The representative species encompass a range of ecological niches in order to achieve the best characterization of the ecosystems being examined and are presented in Table 2-6.

The estimate of chemical concentrations at the ecological receptors was based on the average site-wide concentration of each COC. This approach was appropriate because few of the representative species would inhabit only one distinct site at the installation; they are more likely to be exposed to the mix of chemicals and concentrations detected on all the sites at Barter Island. The potential ecological risks associated with the chemicals detected at the site are presented in Section 3.2.5.

3.2.4 Human Health Risk Assessment

This section presents a summary of the potential human health risks associated with the chemicals detected at the Current Landfill (LF04) site. The purpose of the human health risk assessment is to quantify the excess lifetime cancer risk and/or the noncancer hazard (reported as hazard index) from the chemicals detected at the site.

This summary presents the COCs at the site, the pathways by which human receptors may be exposed to site chemicals, potential risks to human health posed by each chemical through each exposure pathway, the significance of the risk and/or hazard estimate, and a comparison of site chemical concentrations to ARARs. The methods and assumptions used in calculating hazards and risks are presented in Section 2.4.1.

3.2.4.1 Chemicals of Concern. At the Current Landfill (LF04), no COCs were identified for the soil/sediment matrix. Manganese was determined to be a COC in surface water at the site because the maximum concentration detected exceeded the RBSL. Trichloroethane was also determined to be a COC in surface water because the maximum concentration detected exceeded an ARAR.

Table 3-4, Identification of COCs at the Current Landfill, presents the maximum concentrations of chemicals detected at the site and the associated background concentrations, RBSLs, and ARARs, and identifies COCs selected in the risk evaluation.

3.2.4.2 Exposure Pathways and Potential Receptors. Because no COCs were identified for soil/sediment at the Current Landfill site, only ingestion of surface water was evaluated in the risk assessment.

Three potential receptor groups were evaluated in the human health risk assessment: an adult assigned to a DEW Line installation (worker), an adult inhabitant of communities in the North Slope of Alaska (native), and a child living in a North Slope community (child).

3.2.4.3 Risk Characterization.

Noncancer Hazard and Cancer Risk Associated with Soils and Sediments. No COCs were identified for the soil at the Current Landfill (LF04). The concentrations detected in site soil/sediment samples were below those considered acceptable under EPA Region 10 guidance (EPA 1991a) or ARARs.

Noncancer Hazard and Cancer Risk Associated with Surface Water. The noncancer hazard associated with the ingestion of surface water at the Current Landfill by a hypothetical native northern adult or a DEW Line worker is 5.072, based on the maximum concentration of the COC. The presence of manganese accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations. The excess lifetime cancer risk associated with the ingestion of surface water at the site by a hypothetical native northern adult is 6×1^{-6}, and by a DEW Line worker is 8×10^{-7}, based on the maximum concentration of the COC. The presence of trichloroethane accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

3.2.4.4 Summary of Human Health Risk Assessment. The risks and hazards associated with the Current Landfill site are the noncancer hazard index of 5.07 associated with the levels of manganese detected in surface water and the cancer risk of 6×1^{-6} to an adult native associated with levels of trichloroethane in surface water.

These hazards and risks were calculated assuming the affected surface water would be used as a sole-source water supply for 180 days per year. Based on site-specific information, the chemicals in surface water do not currently pose a health hazard nor are they likely to pose a hazard in the future. The surface water expressions at the site are frozen most of the year; many are only intermittently filled with water during the summer months. The surface water at the site is not used for a water supply now, nor has it been used in the past. In conclusion, under current uses the COCs identified in surface water at the Current Landfill site pose only a minimal, if any, potential threat to human health. Based on the human health risk assessment, remedial actions are not warranted at the site. In the unlikely event that surface water at the site is used as a sole-source drinking water supply in the future, a potential noncancer hazard to human health could exist if current conditions remain constant.

3.2.5 Ecological Risk Assessment

The objective of the ERA is to estimate the potential impacts of chemicals detected at the installation to aquatic and terrestrial plants and animals. A summary of the methods used to assess potential ecological impacts is presented in Section 2.4.2.

3.2.5.1 Chemicals of Concern. COCs were selected based on criteria presented in Section 3.1 of the ERA. The average installation-wide concentrations of COCs were used to calculate the risk estimates. Iron and manganese were the COCs detected in surface water at the Current Landfill, while the COCs detected in soils/sediments were DRPH, xylenes, lead, and zinc. Iron and manganese were the only COCs associated with elevated HQs at the Current Landfill.

3.2.5.2 Exposure Pathways and Potential Receptors. Potential exposure pathways for terrestrial and aquatic organisms include direct contact with, and ingestion of, contaminated soil/sediment and/or surface water. The most significant route of exposure for plants is direct contact with soil. Aquatic organisms such as fish and invertebrates are primarily exposed through direct contact with surface water, and average surface water concentrations were used to evaluate potential exposures. They may also be exposed to COCs through ingestion of plant and animal items in their diet and incidental ingestion of soil/sediment while foraging, although these pathways are considered less significant and are not used to calculate HQs. Birds and mammals may be exposed to COCs through ingestion of surface water, ingestion of plant and animal diet items (although only ingestion of plant matter was quantified in the estimated exposure equation), and incidental ingestion of soil/sediment.

The potential ecological receptors evaluated in the risk assessment include plants, aquatic organisms, birds, and mammals likely to occur along the Arctic Coastal Plain. Representative species from these receptor groups were selected based primarily on the species' likelihood of exposure, preferred habitat, and feeding habitats. Species that may be particularly sensitive to environmental impacts, such as threatened and endangered species, are considered on an individual basis if present at or near the installation. Spectacled and Steller's eiders have been identified in the vicinity of the Barter Island installation, although there is a low probability that either species is currently nesting or raising broods on the Barter Island sites (Alaska Biological Research 1994). The ERA evaluation included the spectacled eider, and this evaluation was also used to evaluate any potential risk to Steller's eiders should they be found at the installation. The species evaluated in the ERA are listed in Table 2-6.

3.2.5.3 Risk Characterization. Potential ecological risk at the Current Landfill was associated with the elevated surface water HQs for iron and manganese. The HQs for the arctic char and nine-spined stickleback were nine and eight for iron and manganese, respectively. The HQs for *Daphnia* spp. were nine for iron and three for manganese.

3.2.5.4 Summary of Ecological Risk Assessment. Although the HQs are elevated for iron and manganese in surface water, their essential nutrient status, uncertainty associated with the toxicity reference values for these metals, and the relatively low HQs indicate that the calculated potential risk from these two metals in surface water is subject to mitigating factors. The HQs were developed using the total concentrations of these metals in surface water. The impact to aquatic receptors is likely to be the result of dissolved concentrations, which are within the range of background concentrations for iron and manganese at the Current Landfill site. As a result the potential risk to *Daphnia* spp. at the Current Landfill is not likely to be significant.

The ERA indicates that, although there are a few instances of potential risk to individual species, overall the potential risks presented by the chemicals detected at the site are low.

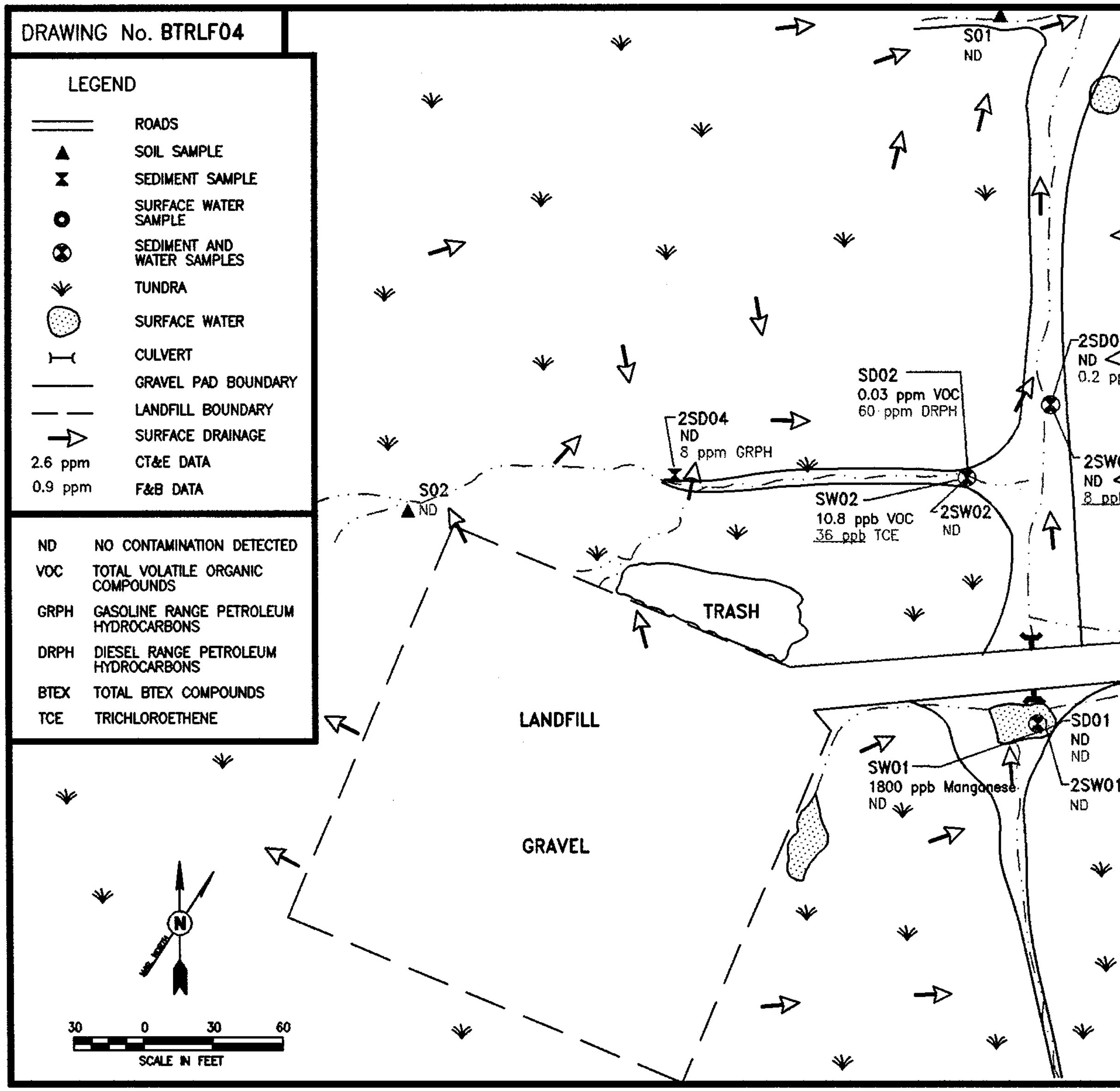
3.2.6 Conclusions and Recommendations

Sampling and analyses have determined that there is no significant contamination at the Current Landfill (LF04) site. Only relatively low levels of contaminants were detected, and their source is suspected to be previous waste disposal at the Current Landfill and/or areas to the north of

the landfill. The village of Kaktovik is no longer using the landfill for disposal of wastes, so there is no longer a source of potential contaminants at the north end of the landfill.

Migration of contaminants from the site appears minimal based on the surface water samples collected in drainage pathways leading from the site.

The risk assessment concluded that risks posed to human health and ecological receptors by site contaminants are minimal given current or future site uses. A potential noncancer hazard was identified in surface water from manganese. This potential human health hazard is based on a future scenario in which the site surface water would be used as a sole drinking water supply, and the noncancer hazard is likely to be overestimated. Even using the conservative future scenario, the potential human health risks at the site are not of a magnitude that normally requires remedial action. Based on the RI sampling and analyses, risk assessment, and current site uses, remedial actions are not warranted at the site. No significant human health or ecological risks were identified at the site. Therefore, the Current Landfill (LF04) site is recommended for no further action.



BARTER ISLAND RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 3-2

CURRENT LANDFILL (LF04) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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TABLE 3-3. CURRENT LANDFILL ANALYTICAL DATA SUMMARY

Installation: Barter Island
Site: Current Landfill (LF04)
Matrix: Soil/Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples S01	S02	SD01	SD02	Field Blanks AB02	EB04	TB04	Lab Blanks	
Laboratory Sample ID Numbers					326	1334	1336 4286-3	1338 4286-4	315 4303-1	311 4302-10	1346 4302-9	#3&4-82493 #3&4-83193 4303 4302	#6-83193 #5-82493 #3&4-82493 #1&2-83193 428
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	6-55	60-550	500[a]	9.55-1,150	<70J[b]	<340[b]	<550[b]	60[b]	NA	NA	NA	NA	<50-<70J
GRPH	0.2-1	2-10	100	<0.4-<9	<2J[b]	<10J[b]	<6J[b]	<2J[b]	<100J[b]	<100J[b]	<100J[b]	<100J	<2J
RRPH (Approx.)	12-56	120-560	2,000[a]	<480	<140	<560	<340	<120	NA	NA	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<1.5	<0.5	<0.28	<0.15					
Benzene	0.003-0.01	0.03-0.1	0.5	<0.020-<0.300	<0.03	<0.1	<0.06	<0.03	<1	<1	<1	<1	<0.02
Toluene	0.003-0.01	0.03-0.1		<0.020-<0.300	<0.03	<0.1	<0.06	<0.03	<1	<1	<1	<1	<0.02
Ethylbenzene	0.003-0.01	0.03-0.1		<0.020-<0.300	<0.03	<0.1	<0.06	<0.03	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.006-0.02	0.06-0.2		<0.040-<0.600	<0.06	<0.2	<0.1	<0.06	<2	<2	<2	<2	<0.04
HVOC 8010	0.003-0.01	0.03-0.1		<0.5J	<0.03J	<0.1J	<0.06J	<0.03J	<1	<1	<1J	<1	NA
VOC 8260													
Toluene	0.020	0.200		<0.025-<0.500	NA	NA	<0.200	0.026	<1	<1	<1	<1	<0.020
SVOC 8270	0.200	0.200		<0.230-<3.50	NA	NA	<0.200	<0.200	NA	<25-75	NA	<10	<0.200
PCBs	0.01-0.07	0.1-0.7	10	<0.020-<0.100	<0.5-<0.7	<0.1	<0.1	<0.1	NA	NA	NA	NA	<0.1-<0.5
TOC				32,000-199,000	NA	NA	198,000	2,860	NA	<5,000	NA	<5,000	NA

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE 3-3. CURRENT LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island   Matrix: Soil/Sediment
Site: Current Landfill (LF04)   Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples		Field Blanks		Lab Blanks	
					2SD03	2SD04	AB03	EB08		
Laboratory Sample ID Numbers					1742 4616-15	1744 4616-16	1712	1719/1720 4616-13	#5-9693 #1&2-9693 #1&2-9493 4616	#6-9593 #1&2-9693 #1&2-9793 4616
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00-6	18.3-60	500	9.55-1,150	<18.3[cd]	<60[b]	NA	<1,000J[b]	<1,000J	<50
GRPH	0.400-0.2	0.400-2	100	<0.400-<9.0	<0.400[c]	8J[b]	<50J[b]	<50J[b]	NA	<0.400-<1J
RRPH (Approx.)	12-64	120-640	2,000[a]	<480	<640	<120	NA	<2,000	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	0.2J	<0.10				
Benzene	0.002-0.01	0.02-0.1	0.5	<0.020-<0.300	<0.1	<0.02	<1	<1	NA	<0.02
Toluene	0.002-0.01	0.02-0.1		<0.020-<0.300	<0.1	<0.02	<3J	<1J	NA	<0.02
Ethylbenzene	0.002-0.01	0.02-0.1		<0.020-<0.300	<0.1	<0.02	<2J	<1	NA	<0.02
Xylenes (Total)	0.004-0.02	0.04-0.2		<0.040-<0.600	0.2J	<0.04	<5J	<2	NA	<0.04
HVOC 8010	0.01-0.05	0.1-0.5		<0.5J	<0.5J	<0.1J	<9J	<5J	NA	<0.1J-<10J
VOC 8260	0.020	0.020		<0.025-<0.500	<0.020	<0.020	NA	<1-6.6	<1	<0.020

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c Sample was analyzed by F&B also; DRPH and GRPH were detected at <310[b] and <5J[b] mg/kg, respectively.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 3-3. CURRENT LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Current Landfill (LF04)
Matrix: Sediment
Units: mg/kg
METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples					Field Blank			Lab Blanks
					SD01	SD02					EB04		
Laboratory Sample ID Numbers					4286-3	4286-4					4302-10		4286 4302
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L		µg/L
Aluminum	0.35	2		1,500-25,000	7,500	1,900					<100		<100
Antimony	N/A	55-260		<7.8-<230	<260	<55					<100		<100
Arsenic	0.11	5.5-26		<4.9-8.5	<26	<5.5					<100		<100
Barium	0.024	1-30		27-390	120	<30					<50		<50
Beryllium	N/A	2.8-13		<2.6-6.4	<13	<2.8					<50		<50
Cadmium	0.33	2.8-13		<3.0-<36	<13	<2.8					<50		<50
Calcium	0.69	4		360-59,000	10,000	7,200					<200		<200
Chromium	0.066	1-13		<4.3-47	<13	3.4					<50		<50
Cobalt	N/A	5.5-26		<5.1-12	<26	<5.5					<100		<100
Copper	0.045	1		<2.7-45	18	9.9					<50		<50
Iron	0.50	2		5,400-35,000	17,000	4,700					<100		<100
Lead	0.13	2-26		<5.1-22	<26	6.1					<100		<100
Magnesium	0.96	4		360-7,400	2,800	3,800					<200		<200
Manganese	0.025	1		25-290	380	40					<50		<50
Molybdenum	N/A	2.8-13		<2.5-<11	<13	<2.8					<50		<50
Nickel	0.11	1		4.2-46	16	4.6					<50		<50
Potassium	23	280-1,300		<300-2,200	<1,300	<280					<5,000		<5,000
Selenium	1.2	5.6-26		<7.8-<170	<26	<5.6					<100		<100

☐ CT&E Data.
N/A Not available.

TABLE 3-3. CURRENT LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Current Landfill (LF04)
Matrix: Sediment
Units: mg/kg
METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples					Field Blank			Lab Blanks
					SD01	SD02					EB04		
Laboratory Sample ID Numbers					4286-3	4286-4					4302-10		4286 4302
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L		µg/L
Silver	0.53	2.8-13		<3-<100	<13	<2.8					<50		<50
Sodium	0.55	5		<160-680	870	89					<250		<250-267
Thallium	0.11	0.26-1.3		<0.2-<1.2	<1.3	<0.26					<5		<5
Vanadium	0.036	1		6.3-59	21	6.3					<50		<50
Zinc	0.16	1		9.2-95	65	31					<50		<50

☐ CT&E Data.

TABLE 3-3. CURRENT LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Surface Water
Site: Current Landfill (LF04) Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples		Field Blanks			Lab Blanks
					SW01	SW02	AB02	EB04	TB04	
Laboratory Sample ID Numbers					1324/1326 4286-1	1328/1330 4286-2	315 4303-1	332 4302-10	1346 4302-9	#5-83193 #5-9693 #3&4-83193 #3&4-82493 4303/4302 4286
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
DRPH	100	1,000		<200	<1,000[b]	<1,000[b]	NA	NA	NA	<1,000J
GRPH	10	100		<20	<100J[b]	<100J[b]	<100J[b]	<100J[b]	<100J[b]	<100J
RRPH (Approx.)	200	2,000		NA	<2,000	<2,000	NA	NA	NA	<2,000
BTEX (8020/8020 Mod.)										
Benzene	0.1	1	5	<1	<1	<1	<1	<1	<1	<1
Toluene	0.1	1	1,000	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	0.1	1	700	<1	<1	<1	<1	<1	<1	<1
Xylenes (Total)	0.2	2	10,000	<1	<2	<2	<2	<2	<2	<2
HVOC 8010										
Trichloroethene	0.1	1	5	NA	<1J	36J	<1	<1	<1J	<1J
VOC 8260										
1,2-Dichloroethane	1	1	5	3U-3.2B	2.6B	2.7B	6.3	1.5	<1	<1
Dichlorodifluoromethane	1	1		<1	<1	3.7	<1	<1	<1	<1

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
J Result is an estimate.
U Compound is not present above the concentration listed.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE 3-3. CURRENT LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island   Matrix: Surface Water
Site: Current Landfill (LF04)   Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples		Field Blanks			Lab Blanks
					SW01	SW02	AB02	EB04	TB04	
Laboratory Sample ID Numbers					1324/1326 4286-1	1328/1330 4286-2	315 4303-1	332 4302-10	1346 4302-9	#5-83193 4303/4302 4286
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
p-Isopropyltoluene	1	1		<1	<1	1.1	<1	<1	<1	<1
Toluene	1	1	1,000	<1	<1	1.3B	2.2	2.3	<1	<1
Trichloroethene	1	1	5	<1	<1	6	<1	<1	<1	<1
SVOC 8270	10	22		<10	<22	<22	NA	<25-75	NA	<10
PCBs	0.2	2	0.5	<1	<2	<2	NA	NA	NA	NA
TOC	5,000	5,000		<5,000-12,700	23,400	26,600	NA	<5,000	NA	<5,000
TSS	100	200		<30,000-8,000	156,000	22,000	NA	NA	NA	<200
TDS	10,000	10,000		<352,000-328,000	905,000	614,000	NA	NA	NA	<10,000

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
B The analyte was detected in the associated blank.

TABLE 3-3. CURRENT LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Surface Water
Site: Current Landfill (LF04) Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks			Lab Blanks
					2SW01	2SW02	2SW03	AB03	EB06	EB08	
Laboratory Sample ID Numbers					1669	1670	1747/1748 4616-14	1712	1688/1690	1719/1720 4616-13	#5-9693 #1&2-9793 #1&2-9493 4616
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
DRPH	100	1,000		<200	<1,000[b]	<1,000[b]	<1,000J[b]	NA	<1,000J[b]	<1,000J[b]	<1,000J
GRPH	5	50		<20	NA	NA	<50J[b]	<50J[b]	<100J[b]	<50J[b]	<2J-<50
RRPH (Approx.)	200	2,000		NA	<2,000	<2,000	<2,000	NA	<2,000	<2,000	<2,000
BTEX (8020/8020 Mod.)											
Benzene	0.1	1	5	<1	NA	NA	<1	<1	<1	<1	<1-<5
Toluene	0.1	1	1,000	<1	NA	NA	<1	<3J	<4J	<1J	<1
Ethylbenzene	0.1	1	700	<1	NA	NA	<1	<2J	<2J	<1	<1
Xylenes (Total)	0.2	2	10,000	<1	NA	NA	<2	<5J	<5J	<2	<2
HVOC 8010											
Trichloroethene	0.1	1	5	NA	NA	NA	8J	<1	<1	<1J	<1-<10J
VOC 8260	1	1		<1-3.2B	NA	NA	<1	NA	NA	<1-6.6	<1

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
J Result is an estimate.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE 3-3. CURRENT LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Current Landfill (LF04)
Matrix: Surface Water
Units: µg/L
METAL ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples					Field Blank			Lab Blanks
					SW01	SW02					EB04		
Laboratory Sample ID Numbers					4286-1	4286-2					4302-10		4286 4302
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L		µg/L
Aluminum	17.4	100		<100-350 (<100-340)	<740J (<100)J	<100 (<100)					<100		<100 (<100)
Antimony	N/A	100	6	<100 (<100)	<100J (<100)J	<100 (<100)					<100		<100 (<100)
Arsenic	5.3	100	50	<100 (<100)	<100J (<100)J	<100 (<100)					<100		<100 (<100)
Barium	1.2	50	2,000	<50-93 (<50-91)	150J (61)J	<50 (<50)					<50		<50 (<50)
Beryllium	N/A	50	4	<50 (<50)	<50J (<50)J	<50 (<50)					<50		<50 (<50)
Cadmium	1.7	50	5	<50 (<50)	<50J (<50)J	<50 (<50)					<50		<50 (<50)
Calcium	34.5	200		4,500-88,000 (4,100-86,000)	120,000J (120,000)J	58,000 (59,000)					<200		<200 (<200)
Chromium	3.29	50	100	<50 (<50)	<50J (<50)J	<50 (<50)					<50		<50 (<50)
Cobalt	N/A	100		<100 (<100)	<100J (<100)J	<100 (<100)					<100		<100 (<100)
Copper	2.3	50	1,300	<50 (<50)	<50J (<50)J	<50 (<50)					<50		<50 (<50)
Iron	25	100		180-2,800 (<100-1,600)	21,000J (890)J	2,400 (2,200)					<100		<100 (<100)

☐ CT&E Data.
N/A Not available.
J Result is an estimate.

TABLE 3-3. CURRENT LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island — Site: Current Landfill (LF04) — Matrix: Surface Water — Units: µg/L — METAL ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples					Field Blank			Lab Blanks
					SW01	SW02					EB04		
Laboratory Sample ID Numbers					4286-1	4286-2					4302-10		4286 4302
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L		µg/L
Lead	6.6	10-100	15	<100 (<100)	<10J (<100)J	<100 (<100)					<100		<100 (<100)
Magnesium	47.8	200		<5,000-53,000 (2,600-54,000)	41,000J (41,000)J	29,000 (28,000)					<200		<200 (<200)
Manganese	1.24	50		<50-510 (<50-120)	1,800J (260)J	150 (150)					<50		<50 (<50)
Molybdenum	N/A	50		<50 (<50)	<50J (<50)J	<50 (<50)					<50		<50 (<50)
Nickel	5.5	50	100	<50 (<50)	<50J (<50)J	<50 (<50)					<50		<50 (<50)
Potassium	1,154	500		<5,000 (<5,000)	5,200J (<5,000)J	12,000 (10,000)					<5,000		<5,000 (<5,000)
Selenium	62.4	100	50	<100 (<100)	<100J (<100)J	<100 (<100)					<100		<100 (<100)
Silver	2.6	50	50	<50 (<50)	<50J (<50)J	<500 (<50)					<50		<50 (<50)
Sodium	27.7	250		8,400-410,000 (8,200-450,000)	100,000J (100,000)J	100,000 (87,000)					<250		267
Thallium	0.57	5	2	<5 (<5)	<5J (<5)J	<5 (<5)					<5		<5 (<5)
Vanadium	1.8	50		<50 (<50)	<50J (<50)J	<50 (<50)					<50		<50 (<50)
Zinc	8.2	50		<50-160 (<50)	<50J (<50)J	<50 (<50)					<50		<50 (<50)

☐ CT&E Data.
N/A Not analyzed.
J Result is an estimate.

TABLE 3-4. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE CURRENT LANDFILL (LF04)

SITE	MATRIX	CHEMICAL DETECTED[a]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[b]		ARAR[c]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Current Landfill	Soil	DRPH	60	mg/kg	9.55-1,150	--	--	500[d]	NO
(LF04)		GRPH	8	mg/kg	<0.400-<9	--	--	100[d]	NO
		Toluene	0.026	mg/kg	<0.020-<0.500	--	5,400	--	NO
		Xylenes	0.2	mg/kg	<0.040-<1.000	--	54,000	--	NO
		Aluminum	7,500	mg/kg	1,500-25,000	--	--	--	NO
		Barium	120	mg/kg	27-390	--	1,890	--	NO
		Calcium	10,000	mg/kg	360-59,000	--	--	--	NO
		Chromium	3.4	mg/kg	<4.3-47	--	135	--	NO
		Copper	18	mg/kg	<2.7-45	--	999	--	NO
		Iron	17,000	mg/kg	5,400-35,000	--	--	--	NO
		Lead	6.1	mg/kg	<5.1-22	--	--	500[e]	NO
		Magnesium	3,800	mg/kg	360-7,400	--	--	--	NO
		Manganese	380	mg/kg	25-290	--	3,780	--	NO
		Nickel	16	mg/kg	4.2-46	--	540	--	NO
		Sodium	870	mg/kg	<160-680	--	--	--	NO
		Vanadium	21	mg/kg	6.3-59	--	189	--	NO
		Zinc	65	mg/kg	9.2-95	--	8,100	--	NO

a The concentrations reported for metals in surface water are total metals.
b Risk-Based Screening Level.
c Applicable or Relvant and Appropriate Requirement.
d ADEC 1991.
e EPA 1989d.
f MCL, 52 FR 25690 (08 July 1987).
g MCL, 56 FR 30266 (01 July 1991).

TABLE 3-4. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE CURRENT LANDFILL (LF04) (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED[a]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[b]		ARAR[c]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Current Landfill	Water	Dichlorofluoromethane	3.7	µg/L	<1	–	–	–	NO
(LF04)		p-Isopropyltoluene	1.1	µg/L	<1	–	–	–	NO
(Continued)		Trichloroethene	36	µg/L	<1	–	–	5[f]	**YES**
		Barium	150	µg/L	<50-93	–	256	2,000[g]	NO
		Calcium	120,000	µg/L	4,100-88,000	–	–	–	NO
		Iron	21,000	µg/L	<100-28,000	–	–	–	NO
		Magnesium	41,000	µg/L	<5,000-54,000	–	–	–	NO
		Manganese	1,800	µg/L	<50-510	–	18.3	–	**YES**
		Potassium	12,000	µg/L	<5,000	–	–	–	NO
		Sodium	100,000	µg/L	8,200-450,000	–	–	–	NO

a The concentrations reported for metals in surface water are total metals.
b Risk-Based Screening Level.
c Applicable or Relvant and Appropriate Requirement.
d ADEC 1991.
e EPA 1989d.
f MCL, 52 FR 25690 (08 July 1987).
g MCL, 56 FR 30266 (01 July 1991).

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3.3 CONTAMINATED DITCH (SD08)

3.3.1 Site Background

The Contaminated Ditch (SD08) site is located approximately 100 yards northeast of the main facility structures. The Contaminated Ditch is a large, deep, natural eroded gully running to the north and discharging to the Beaufort Sea. The village of Kaktovik was located west of the ditch from 1952 to 1964. The ditch was suspected to contain petroleum hydrocarbons from a ruptured fuel line near the warehouse area north of the module trains. Station personnel reported that a general cleanup has been conducted at the ditch and exposed metal debris removed in 1992.

Previous sampling, conducted in 1987 and 1990 by Air Force contractors, detected very low levels of petroleum compounds in surface water at the site. A detailed list of contaminants and concentrations previously detected is presented in the RI/FS Work Plan (U.S. Air Force 1993a).

The site-specific environmental setting describing the topography, surface water drainage, and soil types is presented in the discussion of potential migration pathways, Section 3.3.3.

3.3.2 Field Sampling and Analytical Results

This section describes the RI sampling and analytical results for the samples collected at the Contaminated Ditch (SD08) site. The discussion presents a review of laboratory data, data summary tables, contaminants identified, contaminant trends, and information on suspected source areas.

3.3.2.1 Summary of Samples Collected. A total of 21 samples was collected from gravel pads and streams at the site. These consisted of 12 soil, 5 sediment, and 4 surface water samples. Table 2-2 presents a detailed summary of the samples collected and the analyses performed during the 1993 RI field activities. Locations of all samples collected at the Contaminated Ditch (SD08) and a summary of analytical results above background levels are presented in Figures 3-3 and 3-4.

Twelve soil samples were analyzed for DRPH, GRPH, and BTEX. In addition, five samples were analyzed for RRPH and VOCs.

Five sediment samples were analyzed for DRPH, GRPH, and BTEX. In addition, two samples were analyzed for VOCs, SVOCs, TOC, and total metals.

Four surface water samples were analyzed for DRPH, GRPH, and BTEX. In addition, two samples were analyzed for VOCs, SVOCs, TOC, TSS, TDS, and total and dissolved metals.

3.3.2.2 Analytical Results. The data summary table (Table 3-3) presents analytical results for all samples collected at the site. Detection and quantitation limits, action levels, the associated laboratory and field blanks, and background analytical results are presented for each of the analyses. Background levels are listed to allow direct comparison of naturally occurring organic compounds and inorganic analytes with samples collected from the site. Sample

locations and analytical results for the samples at the site are illustrated in Figures 3-3 and 3-4. All organic compounds detected are presented on the figures except when they were a result of laboratory contamination or field decontamination procedures. These exceptions are presented on the data summary table. Only metals detected above background levels are presented on Figures 3-3 and 3-4.

The following section presents a discussion of organic compounds and inorganic analytes detected above background levels at the site. A discussion of TDS, TSS, and TOC is included.

Organics. Organic compounds detected in soil and sediment samples at the site include DRPH, GRPH, and BTEX. DRPH were detected in nine soil and sediment samples ranging from 7.03 to 2,260 mg/kg. GRPH were detected in seven soil/sediment samples ranging from 2.97 to 171 mg/kg. BTEX compounds were detected in five soil/sediment samples. Total BTEX ranged from 0.099 to 15.54 mg/kg; xylenes were the primary components.

In surface water samples only one organic compound was detected. One VOC (cis-1,2-dichloroethene) was detected at low levels in the duplicate samples SD08-SW04/SW08.

In addition, one other organic compound was detected in two surface water samples at similar concentrations to the field blanks and background samples. This compound,1,2-dichloroethane, was detected at 5.3 μg/L in environmental samples, at 1.6 and 3.0 μg/L in the field blanks, and at 1.3 to 3.2 μg/L in the background samples. These detections are assumed to be the result of field decontamination procedures. The hexane and methanol used in the decontamination procedures may have contained impurities including 1,2-dichloroethane.

Inorganics. No metals were detected at concentrations above background levels in soil or sediment samples at the site.

In surface water samples, metals analyses detected four metals (aluminum, barium, iron, and manganese) above background concentrations.

TOC was reported at 2,780 and 2,900 mg/kg in sediment samples SD08-SD01 and SD08-SD05/SD09, respectively. TOC in surface water was reported at 15,000 and 13,000 μg/L in surface water samples SD08-SW01 and SD08-SW04, respectively. TSS were reported at 57,000 and 8,000 μg/L, and TDS were reported at 662,000 and 610,000 μg/L in the same respective samples.

3.3.2.3 Summary of Site Contamination. Previous sampling, conducted in 1987 and 1990, at the Contaminated Ditch site (SD08) detected TPH at 1,000 μg/L and low levels of solvents in surface water samples. No previous soil sampling was conducted. The results of previous sampling efforts are presented in the RI/FS Work Plan (U.S. Air Force 1993a). The quality of the previous IRP sampling data is unknown as is the data validation, if any, that these data have undergone.

During the 1993 RI, low levels of petroleum compounds were detected in soil/sediment samples collected from the Contaminated Ditch (Table 3-3). Petroleum compounds were detected at

higher levels in the gravel pad near the warehouse area. In the surface water samples collected during the current investigation, one sample contained one VOC at low levels.

A comparison of historical data and current project data indicates that the concentrations of petroleum compounds and VOCs in the surface water in the Contaminated Ditch have decreased. The human health and ecological risks associated with the chemicals detected at the site are presented in Sections 3.3.4 and 3.3.5.

The source of contaminants detected during sampling conducted at the Contaminated Ditch is not clearly defined. The ditch was adjacent to the village of Kaktovik from 1952 to 1964 and was historically used as a waste disposal area. However, site personnel reported that a general site cleanup was conducted in 1992 when exposed drums and other metal products were removed. It is suspected that the ditch contains petroleum hydrocarbons as a result of a ruptured fuel line near the warehouse area. Upgradient areas that also could contribute to the low levels of petroleum compounds detected in the Contaminated Ditch include the POL Catchment (LF03), Heated Storage (SS13), and the Garage (SS14).

Contaminants exceeding ADEC guidance cleanup levels were detected in subsurface gravel pad areas near the warehouses, an upgradient area of the Contaminated Ditch (SD08) site; however, a definitive hot spot or source area was not defined.

3.3.3 Migration Pathways

This section describes the topography and stratigraphy of the site and the migration potential of contaminants from the site. A discussion of receptors and chemical concentrations at receptors is included.

3.3.3.1 Topography and Stratigraphy. The site is comprised of two areas: a stream running through the Contaminated Ditch and a suspected source area (Figures 3-3 and 3-4). The Contaminated Ditch stream becomes progressively more incised as it approaches the Beaufort Sea. The water surface is incised to one to two feet below the tundra surface where the stream passes under the main road. The mouth of the stream (where it reaches the sea) is incised 15 feet below the tundra. Topography in this area is generally flat, and several small tributaries feed into the ditch. Many of these tributaries originate at other sites. The suspected upgradient source area consists of a gravel pad and several warehouse/storage buildings.

During the 1993 RI, permafrost was located at a depth of approximately four feet in tundra areas and under gravel pads. Gravel pad materials were typical gravels and sands associated with these features. Subsurface tundra materials were typical of the stratigraphy found at Barter Island (Section 2.4.4.2).

3.3.3.2 Migration Potential.

Subsurface Migration. Subsurface migration from the Contaminated Ditch is not believed to present a threat because any subsurface flow will be directed into the ditch rather than away from it. Subsurface migration is possible, however, in the suspected source area, DRPH

contamination in the source area is predominantly in the subsurface and may have impacted water quality in the active layer. The gravel pad in the source area slopes gently towards the east, indicating that subsurface drainage will enter the Contaminated Ditch. Active layer water that enters the ditch no longer presents a potential for subsurface migration, but a potential for surface migration is created.

Surface Migration. The Contaminated Ditch is the dominant migration pathway at the site. Analytical data show low levels of petroleum compounds and solvents in soil, sediment, and surface water samples collected in the ditch. This indicates that the ditch has been an active pathway. No analytes were detected in the majority of surface water and sediment samples collected in the ditch area of the site.

Air Transport. Air transportation is not considered to be a significant mode of migration at the site (Section 2.4.4.5).

Summary of Migration Potential. The dominant migration pathway at the site is the Contaminated Ditch stream. Analytical data suggest that some low level contaminant migration has occurred in this stream, but that comparatively little migration has occurred past the second tributary. The main sources of contamination in this ditch are tributaries that enter from other sites. Subsurface migration may be occurring at the contaminant source area, but affected active layer water will discharge to the incised stream. However, sample results indicate this is not a significant migration pathway.

3.3.3.3 Receptors and Chemical Concentrations at Receptors.

Human Receptors. Potential human receptors at the Contaminated Ditch site include Air Force contractor personnel working at the station, visitors to the station, and an occasional local visitor passing the site to get to recreational or subsistence lands. Human receptors could potentially be exposed to the chemicals detected in surface water and soils/sediments at the site. The primary routes of potential exposures at the site are direct contact with soils/sediments, incidental ingestion of soils/sediments, and ingestion of surface water. Because groundwater and air at the Barter Island sites are not considered complete pathways of exposure, these media are not evaluated as potential pathways to human receptors.

The Barter Island Risk Assessment (U.S. Air Force 1996) evaluates in detail the risks to human health from all COCs detected at the site. The potential receptor groups were selected based on their likelihood of exposure to contaminants at the site, and include DEW Line workers at the installation, and native adults and children who may visit the site. The estimated exposure point concentrations for human receptors are based on the maximum concentration of each chemical detected at the site. The potential risks to human health associated with site chemicals at Barter Island are presented in Section 3.1.4.

Ecological Receptors. Ecological receptors were evaluated in detail in the Barter Island Risk Assessment (U.S. Air Force 1996) to determine if plants and animals could potentially be impacted by the chemicals detected at the Barter Island installation. Because of the diversity of the plants and animals in the area of the Barter Island installation, a set of representative species

was selected in the ERA for detailed evaluation. The species include plants, aquatic invertebrates, fish, birds, and mammals. These receptors were selected based on the species' likelihood of exposure given their preferred habitat and feeding habits. The representative species encompass a range of ecological niches in order to achieve the best characterization of the ecosystems being examined. The species evaluated in the ERA are presented in Table 2-6.

The estimate of chemical concentrations at the ecological receptors was based on the average site-wide concentration of each COC. This approach was appropriate because few of the representative species would inhabit only one distinct site at the installation; they are more likely to be exposed to the mix of chemicals and concentrations detected on all the sites at Barter Island. The potential ecological risks associated with the chemicals detected at the site are presented in Section 3.3.5.

3.3.4 Human Health Risk Assessment

This section presents a summary of the potential human health risks associated with the chemicals detected at the Contaminated Ditch (SD08) site. The purpose of the human health risk assessment is to quantify the excess lifetime cancer risk and/or the noncancer hazard (reported as hazard index) from the chemicals detected at the site.

This summary presents the COCs at the site, the pathways by which human receptors may be exposed to site chemicals, potential risks to human health posed by each chemical through each exposure pathway, the significance of the risk and/or hazard estimate, and a comparison of site chemical concentrations to ARARs. The methods and assumptions used in calculating hazards and risks are presented in Section 2.4.1.

3.3.4.1 Chemicals of Concern. At the Contaminated Ditch (SD08), COCs identified for the soil/sediment matrix include DRPH, GRPH, and beryllium. DRPH and GRPH were selected because the concentrations detected exceeded ARARs, and beryllium was selected because the concentration exceeded the RBSL. There were no COCs identified in surface water at the site.

Table 3-6, Identification of COCs at the Contaminated Ditch, presents the maximum concentrations of chemicals detected at the site and the associated background concentrations, RBSLs, and ARARs, and identifies COCs selected in the risk evaluation.

3.3.4.2 Exposure Pathways and Potential Receptors. Because no COCs were identified for surface water at the Contaminated Ditch site, only ingestion of soil/sediment was evaluated in the risk assessment.

Three potential receptor groups were evaluated in the risk assessment: an adult assigned to a DEW Line installation (worker), an adult inhabitant of communities in the North Slope of Alaska (native), and a child living in a North Slope community (child).

3.3.4.3 Risk Characterization.

Noncancer Hazard and Cancer Risk Associated with Soils and Sediments. The noncancer hazard associated with the ingestion of soil at the Contaminated Ditch (SD08) site by a hypothetical native northern adult/child is 0.036, and by DEW Line workers is 0.002, based on the maximum concentrations of the COCs. The presence of DRPH accounts for more than 90 percent of the quantifiable noncancer hazard for these receptor/pathway combinations. The excess lifetime cancer risk associated with the ingestion of soil at the site by a hypothetical native northern adult/child is 2×10^{-4}, and by a DEW Line worker is 1×10^{-7}, based on the maximum concentrations of the COCs. The presence of GRPH and beryllium accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

Noncancer Hazard and Cancer Risk Associated with Surface Water. No COCs were identified for surface water at the site. The concentrations detected in water were below those considered acceptable under EPA Region 10 guidance (EPA 1991a) or ARARs.

3.3.4.4 Summary of Human Health Risk Assessment. The hazards associated with the Contaminated Ditch site are the very low noncancer hazard indices (0.002 and 0.036) associated with the levels of DRPH and GRPH in soil/sediment at the site. The cancer risks at the site are due to GRPH and beryllium in soil/sediment at the site. The potential ingestion of soil by a native child (cancer risk = 2×10^{-4}) results in the only cancer risk that exceeds 1×10^{-4}. These hazards and risks were calculated conservatively based on a residential scenario. Therefore, the noncancer risks associated with the site are minimal and the cancer risks are considered very low.

In conclusion, under current uses the COCs identified in samples from the site pose only a minimal, if any, potential threat to human health. Based on the human health risk assessment, remedial actions are not warranted at the site.

3.3.5 Ecological Risk Assessment

The objective of the ERA is to estimate the potential impacts of chemicals detected at the installation to aquatic and terrestrial plants and animals. A summary of the methods used to assess potential ecological impacts is presented in Section 2.4.2.

3.3.5.1 Chemicals of Concern. COCs were selected based on criteria presented in Section 3.1 of the ERA. The average installation-wide concentrations of COCs were used to calculate the risk estimates. Of the chemicals detected in surface water, aluminum, iron, and manganese were identified as COCs. In soil/sediment at the Contaminated Ditch site, DRPH, ethylbenzene, xylenes, and zinc were identified as COCs. Aluminum and iron in surface water were associated with elevated risk estimates for ecological receptors.

3.3.5.2 Exposure Pathways and Potential Receptors. Potential exposure pathways for terrestrial and aquatic organisms include direct contact with, and ingestion of, contaminated soil/sediment and/or surface water. The most significant route of exposure for plants is direct contact with soil. Aquatic organisms such as fish and invertebrates are primarily exposed

through direct contact with surface water, and average surface water concentrations were used to evaluate potential exposures. They may also be exposed to COCs through ingestion of plant and animal items in their diet and incidental ingestion of soil/sediment while foraging, although these pathways are considered less significant and are not used to calculate HQs. Birds and mammals may be exposed to COCs through ingestion of surface water, ingestion of plant and animal diet items (although only ingestion of plant matter was quantified in the estimated exposure equation), and incidental ingestion of soil/sediment.

The potential ecological receptors evaluated in the risk assessment include plants, aquatic organisms, birds, and mammals likely to occur along the Arctic Coastal Plain. Representative species from these receptor groups were selected based primarily on the species' likelihood of exposure, preferred habitat, and feeding habits. Species that may be particularly sensitive to environmental impacts, such as threatened and endangered species, are considered on an individual basis if present at or near the installation. Spectacled and Steller's eiders have been identified in the vicinity of the Barter Island installation, although there is a low probability that either species is currently nesting or raising broods on the Barter Island sites (Alaska Biological Research 1994). The ERA evaluation included the spectacled eider, and this evaluation was also used to evaluate any potential risk to Steller's eiders should they be found at the installation. The species evaluated in the ERA are listed in Table 2-6.

3.3.5.3 Risk Characterization. Potential risks at the Contaminated Ditch site are related to the elevated surface water HQs for aluminum and iron. The aluminum HQ is three, and the iron HQ is nine for all the aquatic receptors.

3.3.5.4 Summary of Ecological Risk Assessment. Although the elevated aluminum and iron HQs indicate potential risk associated with these metals in surface water at the Contaminated Ditch site, there are mitigating factors. These factors include the uncertainty associated with the toxicity reference values and the use of total concentrations of COCs for the calculation of HQs. The dissolved concentrations are much more likely to be associated with any adverse impacts (rather than total concentrations), and the dissolved concentrations of aluminum and iron are below background concentrations. As a result, no significant risks are expected to result from exposure to aluminum or iron by aquatic receptors at the Contaminated Ditch site.

The ERA indicates that, although there are a few instances of potential risk to individual species, overall the potential risks presented by the chemicals detected at the site are low.

3.3.6 Conclusions and Recommendations

Sampling and analyses have determined that there is no significant contamination at the Contaminated Ditch (SD08) site. With a few exceptions, only relatively low levels of contaminants were detected at the site. Upgradient areas in the vicinity of the warehouses had petroleum hydrocarbons at levels that exceeded cleanup guidelines for gravel pads. A definitive hot spot or source area, however, was not identified. There was no significant contaminant detected downgradient in the ditch, and most surface water samples were non-detect. The suspected source of the contamination in the upgradient portion of the site is a reported diesel spill near warehouse, Building WH1.

Migration of contaminants appears to have occurred on the gravel pad areas to the east of the suspected source area. Migration to the incised stream and downgradient portion of the Contaminated Ditch appears minimal, and the low levels detected in the ditch may be from other upgradient sites.

The risk assessment concluded that risks posed to human and ecological receptors by site contaminants are minimal given current or future site uses. A potential carcinogenic risk of 2×10^{-4} was identified in site soils based on the maximum concentrations of GRPH and beryllium detected at the site. This potential human health risk is based on a future residential scenario and soil ingestion rate. Even using the conservative future scenario, the potential human health risks at the site are not of a magnitude that normally requires remedial action.

Based on the RI sampling and analysis, risk assessment, and current site uses, remedial actions are not warranted at the site. Migration of contaminants appears minimal, and no significant human health or ecological risks were identified at the site. Therefore, the Contaminated Ditch (SD08) site is recommended for no further action.

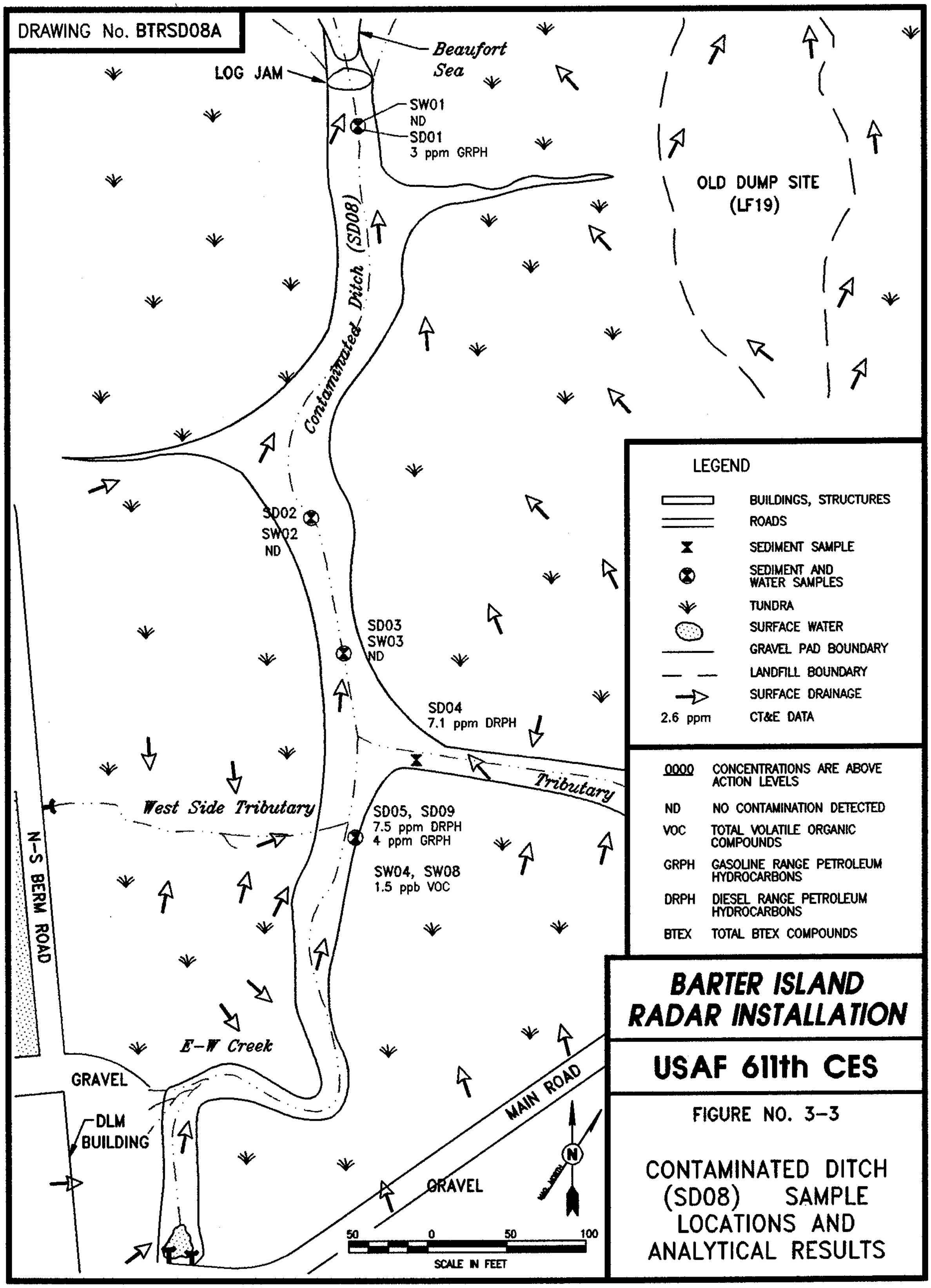

FIGURE NO. 3-3

CONTAMINATED DITCH (SD08) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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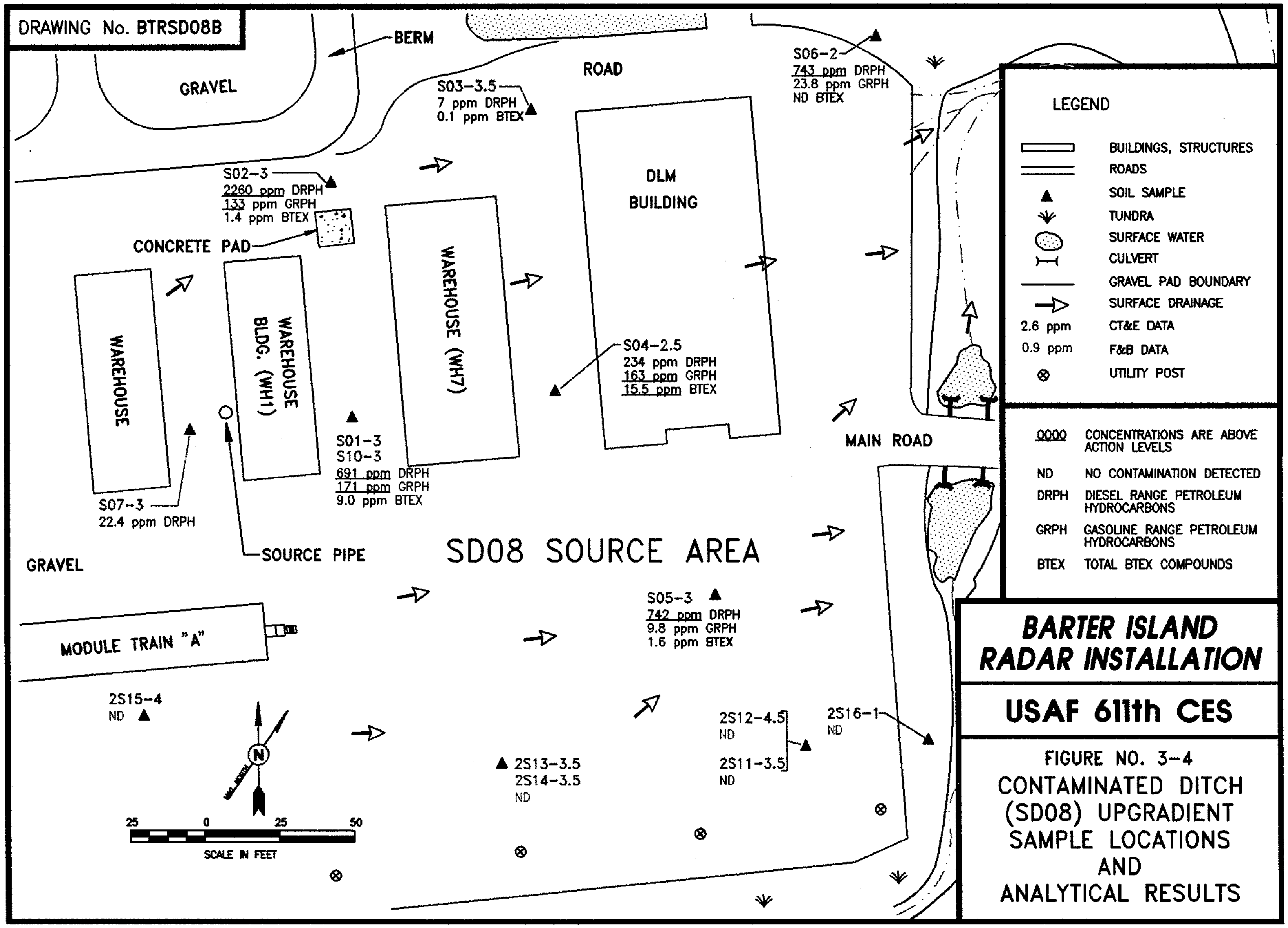

FIGURE NO. 3-4
CONTAMINATED DITCH (SD08) UPGRADIENT SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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TABLE 3-5. CONTAMINATED DITCH ANALYTICAL DATA SUMMARY

Installation: Barter Island Matrix: Soil
Site: Contaminated Ditch (SD08) Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples								Field Blanks			Lab Blanks	
					S01-3 & (Replicates)	S10-3	S02-3	S03-3.5	S04-2.5	S05-3	S06-2	S07-3	AB01	EB01	TB02		
Laboratory Sample ID Numbers					4199-9	4199-8	4203-7	4199-10	4199-12	4199-11	4216-2	4216-1	4173-9	4175-3	4179-5	4203 4199 4197	4199 4203 4216
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	9.55-1,150	691	535	2,260	7.03	234	742[c]	743[e]	22.4[d]	NA	<200	NA	<200	<4.00
GRPH	0.400	0.400	100	<0.4-<9	134	171	133	<0.400	163	9.84	23.8	<0.400	NA	<20	NA	<20	<0.400
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	7.14	9.00	1.367	0.099	15.54	1.629	<0.852	<0.100					
Benzene	0.020	0.020-0.200	0.5	<0.020-<0.300	<0.100	<0.200	<0.020	<0.020	<0.100	<0.100	<0.080	<0.020	<1	<1	<1	<1	<0.020
Toluene	0.020	0.020-0.200		<0.020-<0.300	0.885B	0.182JB	0.210B	0.024B	0.874B	<0.100	0.532B	<0.020	1.2	<1	<1	<1	<0.020
Ethylbenzene	0.020	0.020-0.200		<0.020-<0.300	1.59	2.14	0.113	0.027	3.01	0.279	<0.080	<0.020	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.040-0.400		<0.040-<0.600	5.55	6.86	1.254	0.072	12.53	1.35	<0.160	<0.040	<2	<2	<2	<2	<0.040
VOC 8010	0.020	0.020-0.100		<0.020-<0.300	<0.075	<0.100	<0.020	<0.020	<0.020	<0.020	NA	NA	<1-9.8	<1-2.5	<1	<1	<0.020

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.
B The analyte was detected in the associated blank.
a The action level for DRPH is based on conversations with ADEC; a final action level has not yet been determined.
c The laboratory reported that 213 mg/kg of the EPH pattern in this sample was not consistent with a middle distillate fuel.
d The laboratory reported that 19.9 mg/kg of the EPH pattern in this sample was not consistent with a middle distillate fuel.
e The laboratory reported that the EPH pattern in this sample was not consistent with an unweathered middle distillate fuel.

TABLE 3-5. CONTAMINATED DITCH ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Contaminated Ditch (SD08)
Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples 2S11-3.5	2S12-4.5	2S13-3.5 & 2S14-3.5 (Replicates)		2S15-4	2S16-1	Field Blanks AB03	EB07	Lab Blanks	
Laboratory Sample ID Numbers					1730	1732	1734	1736	1738	1740	1712	1715 1716 4616-9	#5-9693 4616	#6-9593 #1&2-9693
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	mg/kg
DRPH	6	60	500[a]	9.55-1,150	<60[b]	<60[b]	<60[b]	<60[b]	<60[b]	<60[b]	NA	<200[c]	<200	<50
GRPH	0.1	1	100	<0.400-<9.0	<1J[b]	<1J[b]	<1J[b]	<1J[b]	<1J[b]	<1J[b]	<50J[b]	<20[c]	<20	<1J
RRPH (Approx.)	12	120	2,000[a]	<480	<120	<120	<120	<120	<120	<120	NA	<1,000	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10				
Benzene	0.002	0.02	0.5	<0.020-<0.300	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<1	<1	NA	<0.02
Toluene	0.002	0.02		<0.020-<0.300	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<3J	<2J	NA	<0.02
Ethylbenzene	0.002	0.02		<0.020-<0.300	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<2J	<1	NA	<0.02
Xylenes (Total)	0.004	0.04		<0.040-<0.600	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<5J	<2	NA	<0.04

□ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c This sample was analyzed by F&B also; DRPH and GRPH were detected at <1,000J[b] and <50J[b] µg/L, respectively.

TABLE 3-5. CONTAMINATED DITCH ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Contaminated Ditch (SD08)
Matrix: Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples						Field Blanks			Lab Blanks	
					SD01	SD02	SD03	SD04	SD05 & (Replicates)	SD09	AB01	EB01	TB01		
Laboratory Sample ID Numbers					4198-8 4178-3	4198-9	4198-10	4198-11	4198-12 4173-6	4198-13 4178-4	4173-9 4197-6	4203-8 4175-3	4197-7 4173-10	4173 4175 4203	4173 4178 4198
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	9.55-1,150	<4.00	<4.00	<4.00	7.14[c]	4.27	7.46	NA	<200	NA	<200	<4.00
GRPH	0.400	0.400-2.00	100	<0.4-<9	2.97	<0.400	<0.400	<0.400	<2.00	4.05	NA	<20	NA	<20	<0.400
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100					
Benzene	0.020	0.020	0.5	<0.020-<0.300	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<1	<1	<1	<1	<0.020
Toluene	0.020	0.020		<0.020-<0.300	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	1.2	<1	<1	<1	<0.020
Ethylbenzene	0.020	0.020		<0.020-<0.300	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.040		<0.040-<0.600	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<2	<2	<2	<2	<0.040
VOC 8260	0.020	0.020-0.025		<0.025-<0.500	<0.020	NA	NA	NA	<0.025	<0.020	<1-1.9	<1J-4.4J	<1	<1	<0.025
SVOC 8270	0.200	0.200-1.00		<0.23-<3.5	NA	NA	NA	NA	<0.200-<1.00	<0.230	NA	<10	NA	<10	<0.200
TOC				32,000-199,000	2,780	NA	NA	NA	1,670	2,900	NA	7,800	NA	<5,000	NA

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.
a The action level for DRPH is based on conversations with ADEC; a final action level has not yet been determined.
c The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 3-5. CONTAMINATED DITCH ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Contaminated Ditch (SD08)
Matrix: Sediment
Units: mg/kg
METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples						Field Blank			Lab Blanks
					SD01	SD05 & SD09 (Replicates)						EB01		
Laboratory Sample ID Numbers					4178-3	4173-6	4178-4					4175-3		4178 4175 4173
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L		µg/L
Aluminum	0.35	2-2,800		1,500-25,000	<2,800	2,400	2,500					<100		<100
Antimony	N/A	54-57		<7.8-<230	<54	<57	<57					<100		<100
Arsenic	0.11	5.4-5.7		<4.9-8.5	<5.4	<5.7	<5.7					<100		<100
Barium	0.024	1		27-390	27	32	44					<50		<50
Beryllium	N/A	1-2.7		<2.6-6.4	<2.7	3.2	2.8					<50		<50
Cadmium	0.33	1-2.8		<3.0-<36	<2.7	<2.8	2.8					<50		<50
Calcium	0.69	4		360-59,000	12,300	5,000	6,900					<200		<200
Chromium	0.066	1		<4.3-<47	4.4	5.3	4.0					<50		<50
Cobalt	N/A	1-57		<5.1-12	<5.4	<57	5.7					<100		<100
Copper	0.045	1		<2.7-45	4.7	5.8	4.1					<50		<50
Iron	0.50	2		5,400-35,000	9,800	12,000	8,700					<100		<100
Lead	0.13	5.4-5.7		<5.1-22	<5.4	<5.7	<5.7					<100		<100
Magnesium	0.96	4		360-7,400	2,600J	1,400	2,300					<200		<200
Manganese	0.025	1		25-290	98J	250	160					<50		<50
Molybdenum	N/A	2.9-5.7		<2.5-<11	<5.4	<2.9	<5.7					<50		<50
Nickel	0.11	1		4.2-46	7.6	6.6	6.1					<50		<50
Potassium	23	100		<300-2,200	440	336	370					<5,000		<5,000

☐ CT&E Data.
N/A Not available.
J Result is an estimate.

TABLE 3-5. CONTAMINATED DITCH ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Site: Contaminated Ditch (SD08)			Matrix: Sediment Units: mg/kg		METALS ANALYSES									
Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples						Field Blank			Lab Blanks
					SD01	SD05 & SD09 (Replicates)						EB01		
Laboratory Sample ID Numbers					4178-3	4173-6	4178-4					4175-3		4178 4175 4173
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L		µg/L
Selenium	1.2	2-5.7		<7.8-<170	<5.4	57	<5.7					<100		<100
Silver	0.53	2.7-2.9		<3-<110	<2.7	<2.9	<2.8					<50		<50
Sodium	0.55	5		<160-680	80	72	65					<250		<250
Thallium	0.011	0.28		<0.2-<1.2	<0.28J	<0.28	<0.28					<5		<5
Vanadium	0.036	1		6.3-59	7.8	8.4	7.7					<50		<50
Zinc	0.16	1		9.2-95	20J	27	27					<50		<50

☐ CT&E Data.
J Result is an estimate.

TABLE 3-5. CONTAMINATED DITCH ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Contaminated Ditch (SD08)
Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks
					SW01	SW02	SW03	SW04 &	SW08 (Duplicates)	AB01	EB02	TB01	
Laboratory Sample ID Numbers					4178-2 4197-1	4197-2	4197-3	4175-1 4197-4	4173-1 4197-5	4173-9 4197-6	4179-1 4206-4	4197-7 4173-10	4206 4197 4178 4175 4173
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
DRPH	100	200		<200	<200	<200	<200	<200	<200	NA	<100	NA	<100
GRPH	20	20		<20	<20	<20	<20	<20	<20	NA	<20	NA	<20
BTEX (8020/8020 Mod.)													
Benzene	1	1-20	5	<1	<1	<1	<20	<1	<1	<1	<1	<1	<1
Toluene	1	1-20	1,000	<1	<1	<1	<20	<1	<1	1.2	<1	<1	<1
Ethylbenzene	1	1-20	700	<1	<1	<1	<20	<1	<1	<1	<1	<1	<1
Xylenes (Total)	2	2-40	10,000	<2	<2	<2	<40	<2	<2	<2	<2	<2	<2
VOC 8260													
1,2-Dichloroethane	1	1	5	3U-3.2B	5.4B	NA	NA	5.3B	4.4B	1.6	3.0	<1	<1
cis-1,2-Dichloroethene	1	1	70	<1	<1	NA	NA	1.4	1.5	<1	<1	<1	<1
SVOC 8270	10	10		<10	<10	NA	NA	<10	<10	NA	<11	NA	<10
TOC	5,000	5,000		<5,000-12,700	15,000	NA	NA	13,000	11,300	NA	NA	NA	<5,000
TSS	100	200		<30,000-8,000	57,000	NA	NA	6,000	8,000	NA	NA	NA	<200
TDS	10,000	10,000		<352,000-328,000	662,000	NA	NA	610,000	590,000	NA	NA	NA	12,000

☐ CT&E Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
U Compound is not present above the concentration listed.

TABLE 3-5. CONTAMINATED DITCH ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Contaminated Ditch (SD08)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples							Field Blank		Lab Blanks
					SW01	SW04 & SW08 (Replicates)							EB01	
Laboratory Sample ID Numbers					4178-2	4175-1	4173-1						4179-1	4179 4178 4175 4173
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L						µg/L	µg/L
Aluminum	17.4	100		<100-350 (<100-340)	1,900 (<100)	<100 (<100)	<100 (<100)						<100	<100 (<100)
Antimony	N/A	100	6	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)						<100	<100 (<100)
Arsenic	5.3	100	50	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)						<100	<100 (<100)
Barium	1.2	50	2,000	<50-93 (<50-91)	110 (82)	83 (79)	86 (78)						<50	<50 (<50)
Beryllium	N/A	50	4	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)						<50	<50 (<50)
Cadmium	1.7	50	5	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)						<50	<50 (<50)
Calcium	34.5	100		4,500-88,000 (4,100-86,000)	7,200 (71,000)	63,000 (65,000)	63,000 (61,000)						<200	<200 (<200)
Chromium	3.29	50	100	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)						<50	<50 (<50)
Cobalt	N/A	100		<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)						<100	<100 (<100)

☐ CT&E Data.
N/A Not available.

TABLE 3-5. CONTAMINATED DITCH ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Contaminated Ditch (SD08)
Matrix: Surface Water
Units: µg/L
METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples							Field Blank		Lab Blanks
					SW01	SW04 & SW08 (Replicates)							EB01	
Laboratory Sample ID Numbers					4178-2	4175-1	4173-1						4179-1	4179 4178 4175 4173
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L						µg/L	µg/L
Copper	2.3	50	1,300	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)						<50	<50 (<50)
Iron	25	100		180-2,800 (<100-1,600)	4,200 (<100)	2,200 (180)	2,400 (<100)						<100	<100 (<100)
Lead	6.6	100	15	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)						<100	<100 (<100)
Magnesium	47.8	100		<5,000-53,000 (2,600-54,000)	31,000 (30,000)	27,000 (27,000)	27,000 (27,000)						<200	<200 (<200)
Manganese	1.24	100		<50-510 (50-120)	170 (100)	150 (130)	150 (120)						<50	<50 (<50)
Molybdenum	N/A	50		<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)						<50	<50 (<50)
Nickel	5.5	50	100	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)						<50	<50 (<50)
Potassium	1,154	5,000		<5,000 (<5,000)	<5,000 (<5,000)	<5,000 (<5,000)	<5,000 (<5,000)						<5,000	<5,000 (<5,000)
Selenium	62.4	100	50	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)						<100	<100 (<100)
Silver	2.6	50	50	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)						<50	<50 (<50)

☐ CT&E Data.
N/A Not available.

TABLE 3-5. CONTAMINATED DITCH ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Contaminated Ditch (SD08)
Matrix: Surface Water
Units: μg/L
METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples							Field Blank		Lab Blanks
					SW01	SW04 & SW08 (Replicates)							EB01	
Laboratory Sample ID Numbers					4178-2	4175-1	4173-1						4179-1	4179 4178 4175 4173
ANALYSES	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L						μg/L	μg/L
Sodium	27.7	100		8,400-410,000 (8,200-450,000)	120,000 (96,000)	98,000 (91,000)	90,000 (85,000)						<250	<250 (<250)
Thallium	0.57	5	2	<5 (<5)	<5 (<5)	<5 (<5)	<5 (<5)						<5	<5 (<5)
Vanadium	1.8	50		<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)						<50	<50 (<50)
Zinc	8.2	50		<50-160 (<50)	<50 (<50)	<50 (<50)	<50 (<50)						<50	<50 (<50)

☐ CT&E Data.

TABLE 3-6. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE CONTAMINATED DITCH (SD08)

SITE	MATRIX	CHEMICAL DETECTED[a]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[b]		ARAR[c]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Contaminated Ditch (SD08)	Soil	DRPH	2,260	mg/kg	9.55-1,150	--	--	500[d]	YES
		GRPH	171	mg/kg	<0.400-<9	--	--	100[d]	YES
		Ethylbenzene	3.01	mg/kg	<0.020-<0.500	--	2,700	--	NO
		Xylenes	12.53	mg/kg	<0.040-<1.000	--	54,000	--	NO
		Aluminum	2,500	mg/kg	1,500-25,000	--	--	--	NO
		Barium	44	mg/kg	27-390	--	1,890	--	NO
		Beryllium	3.2	mg/kg	<2.6-64	0.0149	135	--	YES
		Cadmium	2.8	mg/kg	<3.0-<36	--	27	--	NO
		Calcium	12,300	mg/kg	360-59,000	--	--	--	NO
		Chromium	5.3	mg/kg	<4.3-47	--	135	--	NO
		Cobalt	5.7	mg/kg		--	--	--	NO
		Copper	5.8	mg/kg	<2.7-45	--	999	--	NO
		Iron	12,000	mg/kg	5,400-35,000	--	--	--	NO
		Magnesium	2,600	mg/kg	360-7,400	--	--	--	NO
		Manganese	250	mg/kg	25-290	--	3,780	--	NO
		Nickel	7.6	mg/kg	4.2-46	--	540	--	NO
		Potassium	440	mg/kg	<300-2,200	--	--	--	NO
		Selenium	57	mg/kg	<7.8-<170	--	135	--	NO
		Sodium	80	mg/kg	<160-680	--	--	--	NO

a The concentrations reported for metals in surface water are total metals.
b Risk-Based Screening Level.
c Applicable or Relevant and Appropriate Requirement.
d ADEC 1991.
e MCL, 56 FR 3526 (30 January 1991).
f MCL, 56 FR 30266 (01 July 1991).

TABLE 3-6. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE CONTAMINATED DITCH (SD08) (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED[a]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[b]		ARAR[c]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Contaminated Ditch	Soil	Vanadium	8.4	mg/kg	6.3-59	--	189	--	NO
(SD08)	(Continued)	Zinc	27	mg/kg	9.2-95	--	8,100	--	NO
(Continued)	Water	cis-1,2-Dichloroethene	1.5	µg/L	<1	--	36.5	70[e]	NO
		Aluminum	1,900	µg/L	<100-350	--	--	--	NO
		Barium	110	µg/L	<50-93	--	256	2,000[f]	NO
		Calcium	71,000	µg/L	4,100-88,000	--	--	--	NO
		Iron	4,200	µg/L	<100-2,800	--	--	--	NO
		Magnesium	31,000	µg/L	<5,000-54,000	--	--	--	NO
		Manganese	170	µg/L	<50-510	--	18.3	--	NO
		Sodium	120,000	µg/L	8,200-450,000	--	--	--	NO

a The concentrations reported for metals in surface water are total metals.
b Risk-Based Screening Level.
c Applicable or Relevant and Appropriate Requirement.
d ADEC 1991.
e MCL, 56 FR 3526 (30 January 1991).
f MCL, 56 FR 30266 (01 July 1991).

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3.4 OLD RUNWAY DUMP (LF12)

3.4.1 Site Background

The Old Runway Dump (LF12) site is located on the northeast corner of Barter Island, east of the runway. It is a two-acre area suspected of receiving wastes generated during the construction of the installation and for a short period thereafter. The site received construction debris, old vehicles, drums, and all other waste generated during this period. The landfill has been closed since 1957 and reportedly was cleaned up between 1979 and 1980. The Old Runway Dump consists of beach gavels and sands, and the area is seasonally covered with sea water. The most northern portion of the site is used by the community of Kaktovik to dispose of whale carcasses.

The site-specific environmental setting describing the topography, surface water drainage, and soil types is presented in the discussion of potential migration pathways, Section 3.4.3.

3.4.2 Field Sampling and Analytical Results

This section describes the RI sampling and analytical results for samples collected at the Old Runway Dump (LF12) site. The discussion presents a review of laboratory data, data summary tables, contaminants identified, contaminant trends, and information on suspected source areas.

3.4.2.1 Summary of Samples Collected. A total of three soil samples was collected at the site. Table 2-2 presents a detailed summary of the samples collected and the analyses performed during the 1993 RI field activities. Locations of all samples collected at the Old Runway Dump (LF12) and a summary of analytical results above background levels are presented in Figure 3-5.

All of the soil samples were analyzed for DRPH, GRPH, RRPH, BTEX, HVOCs, and PCBs. In addition, one of the samples was analyzed for pesticides, VOCs, SVOCs, total metals, and TOC.

3.4.2.2 Analytical Results. The data summary table (Table 3-4) presents analytical results for all samples collected at the site. Detection and quantitation limits, action levels, associated laboratory and field blanks, and background analytical results are presented for each of the analyses. Background levels are listed to allow direct comparison of naturally occurring organic compounds and inorganic analytes with samples collected from the site. Sample locations and analytical results for the samples at the site are illustrated in Figure 3-5. All organic compounds detected are presented on the figure except when they were a result of laboratory contamination or decontamination procedures. These exceptions are presented on the data summary table. Only metals detected above background levels are presented on Figure 3-5.

The following section presents a discussion of organic compounds and inorganic analytes detected above background levels at the site. A discussion of the TOC result is included.

Organics. No organic compounds were detected at the site.

Inorganics. No metals were detected above background concentrations at the site. TOC was reported at 7,680 mg/kg in soil sample LF12-S01.

3.4.2.3 Summary of Site Contamination. No contaminants were detected, and no previous sampling has been conducted at the site. Therefore, migration pathways and risks to human health and the environment are not a concern because there is no contaminant to evaluate.

3.4.3 Conclusions and Recommendations

Sampling and analyses have determined that the Old Runway Dump (LF12) is not contaminated. No contaminant was detected in site samples. The site is subject to seasonal flooding by saltwater, so if contaminants were previously present they were probably diluted by seawater. Because no contaminant was detected at the site, there is no potential for contaminant migration or risk from the site to human health or ecological receptors. Based on the RI sampling and analyses, the Old Runway Dump (LF12) site is recommended for no further action.

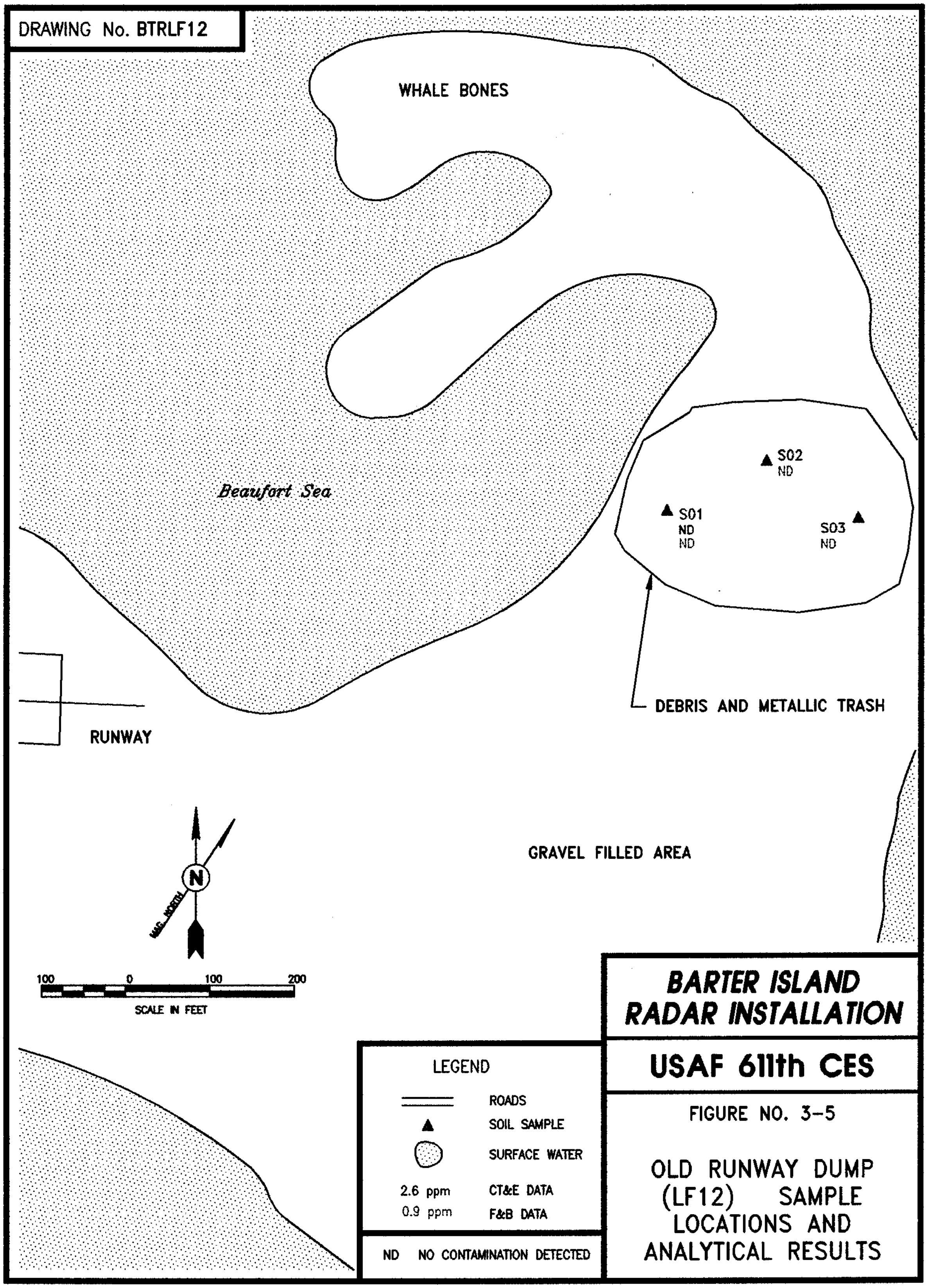
DRAWING No. BTRLF12
WHALE BONES
Beaufort Sea
S02
ND
S01
ND
ND
S03
ND
DEBRIS AND METALLIC TRASH
RUNWAY
GRAVEL FILLED AREA
N
MAG. NORTH
100 0 100 200
SCALE IN FEET
LEGEND
ROADS
SOIL SAMPLE
SURFACE WATER
2.6 ppm CT&E DATA
0.9 ppm F&B DATA
ND NO CONTAMINATION DETECTED
BARTER ISLAND RADAR INSTALLATION
USAF 611th CES
FIGURE NO. 3-5
OLD RUNWAY DUMP (LF12) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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TABLE 3-7. OLD RUNWAY DUMP ANALYTICAL DATA SUMMARY

Installation: Barter Island   Matrix: Soil
Site: Old Runway Dump (LF12)   Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks			Lab Blanks	
					S01	S02	S03	AB02	EB05	TB05		
Laboratory Sample ID Numbers					416 4305-10	412	414	315 4303-1	332 392 4303-5	375	#3&4-82493 #1&2-82493 4303	#6-82393 #1&2-82493 4305
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5	50	500[a]	9.55-1,150	<50J[b]	<50J[b]	<50J[b]	NA	<1000[b]	NA	NA	<50J
GRPH	0.2	2	100	<0.4-<9	<2J[b]	<2J[b]	<2J[b]	<100J[b]	<100J[b]	<50J[b]	<100J	<2J
RRPH (Approx.)	10	100	2,000[a]	<480	<100	<100	<100	NA	<1000	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.10J	<0.10J	<0.10J					
Benzene	0.002	0.02	0.5	<0.020-<0.300	<0.02J	<0.02J	<0.02J	<1	<1	<1	<1	<0.02J
Toluene	0.002	0.02		<0.020-<0.300	<0.02	<0.02	<0.02	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002	0.02		<0.020-<0.300	<0.02	<0.02	<0.02	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004	0.04		<0.040-<0.600	<0.04	<0.04	<0.04	<2	<2	<2	<2	<0.04
HVOC (8010 Mod.)	0.002	0.02		<0.50J	<0.02J	<0.02J	<0.02J	<1	<1	<1	<1	<0.02J
VOC 8260	0.020	0.020		<0.025-<0.500	<0.02	NA	NA	<1-6.3	<1-3.2	NA	<1	<0.020
SVOC 8270	0.200	0.200-1.00		<0.230-<3.50	<0.200-<1.00	NA	NA	NA	<1	NA	<10	<0.200
PCBs	0.05	0.5	10	<0.020-<0.100	<0.5	<0.5	<0.5	NA	<10	NA	NA	<0.1-<0.5
Pesticides	0.001-0.05	0.01-0.5		<0.001-<0.100	<0.01J-<0.5J	NA	NA	NA	<0.2-<10	NA	NA	<0.01-<0.5
TOC				32,000-199,000	7,680	NA	NA	NA	<5,000J	NA	<5,000	NA

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE 3-7. OLD RUNWAY DUMP ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Old Runway Dump (LF12)

Matrix: Soil
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installation	Environmental Samples							Field Blank			Lab Blanks
					S01								EB05		
Laboratory Sample ID Numbers					4305-10								4303-5		4305 4303
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg								µg/L		µg/L
Aluminum	0.35	2		1,500-25,000	1,700								<100		<100
Antimony	N/A	52		<7.8-<230	<52								<100		<100
Arsenic	0.11	5.2		<4.9-8.5	<5.2								<100		<100
Barium	0.024	1		27-390	16								<50		<50
Beryllium	N/A	2.6		<2.6-6.4	<2.6								<50		<50
Cadmium	0.33	2.6		<3.0-<36	<2.6								<50		<50
Calcium	0.69	4		360-59,000	2,200								<200		<200
Chromium	0.066	1		<4.3-4.7	4.5								<50		<50
Cobalt	N/A	5.2		<5.1-12	<5.2								<100		<100
Copper	0.045	1		<2.7-45	7.3								<50		<50
Iron	0.50	2		5,400-35,000	7,500								200		<100
Lead	0.13	5.2		<5.1-22	<5.2								<100		<100
Magnesium	0.96	4		360-7,400	1,100								<200		<200
Manganese	0.025	1		25-290	67								<50		<50
Molybdenum	N/A	2.6		<2.5-<11	<2.6								<50		<50
Nickel	0.11	1		4.2-46	5.3								<50		<50
Potassium	23	260		<300-2,200	<260								<5,000		<5,000

☐ CT&E Data.
N/A Not available.

TABLE 3-7. OLD RUNWAY DUMP ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Old Runway Dump (LF12)

Matrix: Soil
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installation	Environmental Samples							Field Blank			Lab Blanks
					S01								EB05		
Laboratory Sample ID Numbers					4305-10								4303-5		4305 4303
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg								µg/L		µg/L
Selenium	1.2	52		<7.8-<170	<52								<100		<100
Silver	0.53	2.6		<3-<110	<2.6								<50		<50
Sodium	0.55	5		<160-680	410								<250		<250-267
Thallium	0.011	0.25		<0.2-<1.2	<0.25								<5		<5
Vanadium	0.036	1		6.3-59	5.1								<50		<50
Zinc	0.16	1		9.2-95	16								<50		<50

☐ CT&E Data.

TABLE 3-8. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE OLD RUNWAY DUMP (LF12)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a]		ARAR[b]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Old Runway Dump (LF12)	Soil	Aluminum	1,700	mg/kg	1,500-25,000	--	--	--	NO
		Barium	16	mg/kg	27-390	--	1,890	--	NO
		Calcium	2,200	mg/kg	360-59,000	--	--	--	NO
		Chromium	4.5	mg/kg	<4.3-47	--	135	--	NO
		Copper	7.3	mg/kg	<2.7-45	--	999	--	NO
		Iron	7,500	mg/kg	5,400-35,000	--	--	--	NO
		Magnesium	1,100	mg/kg	360-7,400	--	--	--	NO
		Manganese	67	mg/kg	25-290	--	3,780	--	NO
		Nickel	5.3	mg/kg	4.2-46	--	540	--	NO
		Sodium	410	mg/kg	<160-680	--	--	--	NO
		Vanadium	5.1	mg/kg	6.3-59	--	189	--	NO
		Zinc	16	mg/kg	9.2-95	--	8,100	--	NO

a Risk-Based Screening Level.
b Applicable or Relevant and Appropriate Requirement.

3.5 WEATHER STATION BUILDING (SS15)

3.5.1 Site Background

The Weather Station Building (SS15) site is located northwest of the module trains and southwest of the Current Landfill (LF04). The Weather Station Building is an approximately 30 feet by 30 feet building elevated approximately five feet above the center of a gravel pad. A 1,200 gallon aboveground fuel storage tank is located at the northeast corner of the building. The diesel tank has leaked over the years, and a stained area was observed just below the tank fittings.

Previous soil samples from the site contained diesel range petroleum hydrocarbons (Shannon and Wilson 1992); the diesel fuel tank is the suspected source (Table 1-2). A detailed list of concentrations previously detected is presented in the RI/FS Work Plan (U.S. Air Force 1993a).

The site-specific environmental setting describing the topography, surface water drainage, and soil types is presented in the discussion of potential migration pathways, Section 3.5.3.

3.5.2 Field Sampling and Analytical Results

This section describes the RI sampling and analytical results for the Weather Station Building site. The discussion presents a review of laboratory data, data summary tables, contaminants identified, contaminant trends, and information on suspected source areas.

3.5.2.1 Summary of Samples Collected. A total of eight soil samples was collected at the Weather Station Building (SS15) site. Table 2-2 presents a detailed summary of the samples collected and the analyses performed during the 1993 RI field activities. Locations of all samples collected at the Weather Station Building (SS15) site and a summary of analytical results above background levels are presented in Figure 3-6.

The eight soil samples collected adjacent to the aboveground fuel storage tank and on the gravel pad were analyzed for DRPH, GRPH, and BTEX. In addition, three of the soil samples were analyzed for RRPH. One soil sample was analyzed for VOCs.

3.5.2.2 Analytical Results. The data summary table (Table 3-9) presents analytical results for all samples collected at the site. Detection and quantitation limits, action levels, associated laboratory and field blanks, and background analytical results are presented for each of the analyses. Background levels are listed to allow direct comparison of naturally occurring organic compounds and inorganic analytes with the samples collected from this site. Sample locations and analytical results for the samples collected at the site are illustrated in Figure 3-6. All organic compounds detected are presented on the figure except when they were a result of laboratory contamination or field decontamination procedures. The exceptions are presented on the data summary table. The following section presents a discussion of organic compounds detected at the site.

Organics. Organic compounds detected in soil and sediment samples at the site include DRPH, GRPH, BTEX compounds, and two other VOCs. DRPH were detected in five samples ranging

from 107 to 8,420 mg/kg. GRPH (probably lighter ends of diesel fuel) were detected in six samples ranging from 1.46 to 1,020 mg/kg. BTEX compounds were detected in the same six samples. Total BTEX ranged from 0.023 to 3.567 mg/kg; the primary component was xylene. Two other VOCs, both components of diesel fuel, were detected in SS15-S03 at 0.083 and 0.084 mg/kg.

Inorganics. Metals were not a concern at the site, and no metals analyses were performed.

3.5.2.3 Summary of Site Contamination. Previous sampling conducted at the Weather Station Building (SS15) detected DRPH at levels that were highest in the soils under the fuel tank fill port, decreasing with distance from the tank. The concentration of DRPH previously detected under the fuel tank fill port was reported to be 3,400 mg/kg (Shannon and Wilson 1992). The results and the sources of the previous IRP sampling efforts are presented in the RI/FS Work Plan (U.S. Air Force 1993a). The quality of the previous IRP sampling data is unknown as is the data validation, if any, that these data have undergone.

Current analytical results indicate DRPH at concentrations of 6,100 and 8,420 mg/kg in soil samples collected below the fuel tank fill port, decreasing to concentrations ranging from 107 to 2,090 mg/kg away from the tank. GRPH were detected at higher concentrations in soil samples collected under the fuel fill port at 216 and 1,020 mg/kg; the GRPH concentration also decreased with distance from this area to levels ranging from 1.46 to 11.1 mg/kg. The GRPH detected in these samples are probably the lighter fractions of DRPH.

A comparison of historical data and current project data indicates the petroleum hydrocarbons are generally within the same range of concentration. The human health and ecological risks associated with the chemicals detected at the site are presented in Section 3.5.4 and 3.5.5.

The source of the petroleum hydrocarbon (DRPH and GRPH) contamination detected during sampling conducted at the Weather Station Building is suspected to be spills or leaks from the fuel fill port of the 1,200-gallon diesel tank located at the northeast corner of the building. In both current and previous sampling conducted at this site, the highest level of contamination is below the fuel fill port and decreases with distance.

3.5.3 Migration Pathways

This section describes the topography and stratigraphy of the site and the migration potential of contaminants from the site. A discussion of receptors and chemical concentrations at receptors is included.

3.5.3.1 Topography and Stratigraphy. The topography of the site consists of a gravel pad placed on relatively flat tundra (Figure 3-6). The gravel pad is surrounded by wet, marshy tundra on the west, north, and east sides during the summer. Although the tundra is dotted with small ponds, no drainage channels were observed. The landscape slopes slightly from south to north. The edge of the gravel pad is poorly defined (it feathers into the tundra).

During the 1993 RI, permafrost was located at a depth of approximately two and a half feet in tundra areas and four feet under the gravel pad. Gravel pad materials were typical gravels and sands associated with these features, and subsurface tundra materials were typical of the stratigraphy found at Barter Island (Section 2.4.4.2).

3.5.3.2 Migration Potential.

Subsurface Migration. The topography indicates that any subsurface flow is towards the north. Because the topography in this area is relatively flat there will only be a slight hydraulic gradient; the resulting flow of active layer water will be relatively sluggish. One soil sample near the perimeter of the pad contained very low levels of petroleum compounds indicating that relatively little subsurface migration of these compounds occurs past the gravel pad margins. Several non-detect samples at this site support the limited migration of DRPH.

Surface Migration. There are no clearly defined drainage features in this area. Significant surface flow is probably confined to the spring thaw, when large quantities of meltwater are available. At this time, water flows over the tundra in a sheet-like fashion independent of drainage features. The several non-detect samples and the relatively low concentrations of petroleum compounds detected in one soil sample near the edge of the gravel pad indicate that little migration is occurring.

Air Transport. Air transportation is not considered to be a significant mode of migration at the site (Section 2.4.4.5).

Summary of Migration Potential. The potential for offsite migration of contaminants appears to be low. Migration, if it occurs, is probably restricted to the spring thaw during sheet-flow events of runoff water.

3.5.3.3 Receptors and Chemical Concentrations at Receptors.

Human Receptors. Potential human receptors at the Weather Station Building site include Air Force contractor personnel working at the station, visitors to the station, and an occasional local visitor passing the site to get to recreational or subsistence lands. Human receptors could potentially be exposed to the chemicals detected in soils/sediments at the site. The primary routes of potential exposures at the site are direct contact with soils/sediments and incidental ingestion of soils/sediments. Surface water was not considered a route of exposure at the site because no surface waters are associated with the site. Because groundwater and air at the Barter Island sites are not considered complete pathways of exposure, these media are not evaluated as potential pathways to human receptors.

The Barter Island Risk Assessment (U.S. Air Force 1996) evaluates in detail the risks to human health from all COCs detected at the site. The potential receptor groups were selected based on their likelihood of exposure to contaminants at the site, and include DEW Line workers at the installation, and native adults and children who may visit the site. The estimated exposure point concentrations for human receptors are based on the maximum concentration of each chemical

detected at the site. The potential risks to human health associated with site chemicals at Barter Island are presented in Section 3.5.4.

Ecological Receptors. Ecological receptors were evaluated in detail in the Barter Island Risk Assessment (U.S. Air Force 1996) to determine if plants and animals could potentially be impacted by the chemicals detected at the Barter Island installation. Because of the diversity of the plants and animals in the area of the Barter Island installation, a set of representative species was selected in the ERA for detailed evaluation. The species include plants, aquatic invertebrates, fish, birds, and mammals. These receptors were selected based on the species' likelihood of exposure given their preferred habitat and feeding habits. The representative species encompass a range of ecological niches in order to achieve the best characterization of the ecosystems being examined and are presented in Table 2-6.

The estimate of chemical concentrations at the ecological receptors was based on the average site-wide concentration of each COC. This approach was appropriate because few of the representative species would inhabit only one distinct site at the installation; they are more likely to be exposed to the mix of chemicals and concentrations detected on all the sites at Barter Island. The potential ecological risks associated with the chemicals detected at the site are presented in Section 3.5.5.

3.5.4 Human Health Risk Assessment

This section presents a summary of the potential human health risks associated with the chemicals detected at the Weather Station Building (SS15) site. The purpose of the human health risk assessment is to quantify the excess lifetime cancer risk and/or the noncancer hazard (reported as hazard index) from the chemicals detected at the site.

This summary presents the COCs at the site, the pathways by which human receptors may be exposed to site chemicals, potential risks to human health posed by each chemical through each exposure pathway, the significance of the risk and/or hazard estimate, and a comparison of site chemical concentrations to ARARs. The methods and assumptions used in calculating hazards and risks are presented in Section 2.4.1.

3.5.4.1 Chemicals of Concern. At the Weather Station Building (SS15), COCs identified in the soil/sediment at the site were DRPH and GRPH. These COCs were selected because the maximum concentrations detected exceeded ARARs. No surface water bodies were associated with the site, and no water samples were collected. Therefore, there are no surface water COCs.

Table 3-10, Identification of COCs at the Weather Station Building, presents the maximum concentrations of chemicals detected at the site and the associated background concentrations, RBSLs, and ARARs, and identifies COCs selected in the risk evaluation.

3.5.4.2 Exposure Pathways and Potential Receptors. Because no surface water bodies were identified at the Weather Station Building site, only ingestion of soil/sediment was evaluated in the human health risk assessment.

Three potential receptor groups were evaluated in the risk assessment: an adult assigned to a DEW Line installation (worker), an adult inhabitant of communities in the North Slope of Alaska (native), and a child living in a North Slope community (child).

3.5.4.3 Risk Characterization.

Noncancer Hazard and Cancer Risk Associated with Soils and Sediments. The noncancer hazard associated with the ingestion of soil at the Weather Station Building (SS15) by a hypothetical native northern adult/child is 0.134, and by a DEW Line worker is 0.006, based on the maximum concentrations of the COCs. The presence of DRPH and GRPH accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations. The excess lifetime cancer risk associated with the ingestion of soil at the site by a hypothetical native northern adult/child is 3×10^{-7}, and by a DEW Line worker is 1×10^{-4}, based on the maximum concentrations of the COCs. The presence of GRPH accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

Noncancer Hazard and Cancer Risk Associated with Surface Water. No surface water bodies were identified at the Weather Station Building (SS15); therefore, there is no apparent surface water pathway and no evaluation of noncancer hazard or excess lifetime cancer risk associated with ingestion of surface water at the site was conducted.

3.5.4.4 Summary of Human Health Risk Assessment. The potential risks and hazards associated with the soil/sediment at the Weather Station Building are the very low noncancer hazards (hazard indices of 0.006 and 0.134) associated with the DRPH and GRPH detected at the site. The noncancer hazards are below one and were calculated conservatively based maximum concentrations detected and residential scenario. Therefore, the noncancer hazards associated with soil/sediment at the site are minimal.

In conclusion, under current uses the COCs identified in soil/sediment at the Weather Station Building site pose only a minimal, if any, potential threat to human health. Based on the human health risk assessment, remedial actions are not warranted at the site.

3.5.5 Ecological Risk Assessment

The objective of the ERA is to estimate the potential impacts of chemicals detected at the installation to aquatic and terrestrial plants and animals. A summary of the methods used to assess potential ecological impacts is presented in Section 2.4.2.

3.5.5.1 Chemicals of Concern. COCs were selected based on the average installation-wide concentration of chemicals detected at the Barter Island sites. Only sites where useable habitat exists and that were likely used by ecological receptors were included in the ecological risk evaluation. The Weather Station Building (SS15) site was determined not to consist of usable habitat for ecological receptors because the contaminated portion of the site consists only of a very limited area of gravel pad. There were no surface water bodies associated with the site, and the only affected medium is the gravel pad.

The site was determined not to be suitable habitat for ecological receptors, so no risk assessment was conducted.

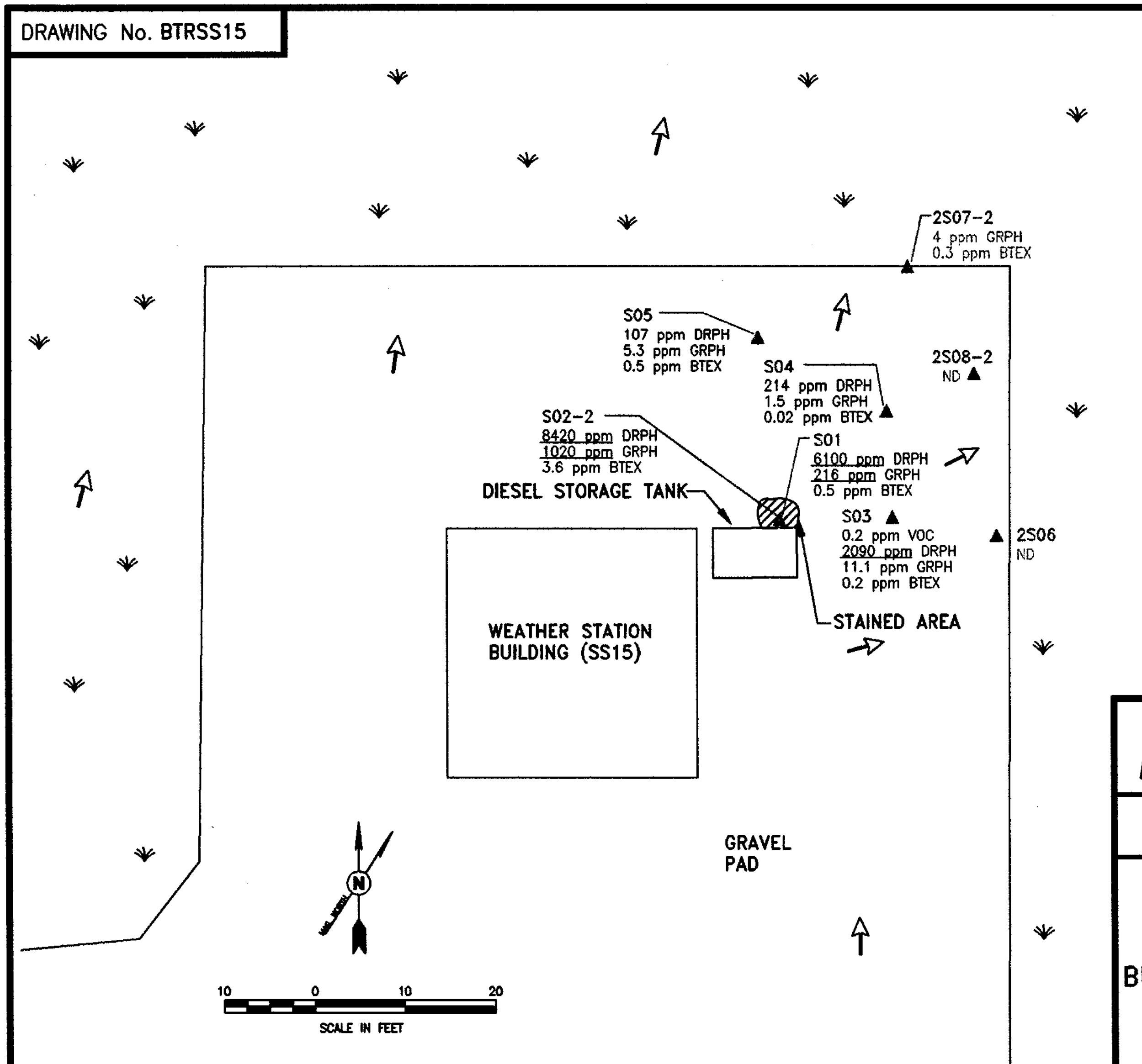
3.5.5.2 Summary of Ecological Risk Assessment. The Weather Station Building site was not evaluated in the ERA because it did not provide suitable habitat for potential ecological receptors. Exposures to COCs by the representative species at this site were not expected. In addition, the potential risks presented by the chemicals detected at the site were evaluated at other sites, and potential ecological risks were determined to be minimal.

3.5.6 Conclusions and Recommendations

Sampling and analyses have determined that a small area at the Weather Station Building (SS15) site is contaminated with relatively low levels of petroleum hydrocarbons (DRPH and GRPH) and BTEX compounds. The contaminated areas at the site are in the gravel pad below and down gradient of the onsite diesel storage tank. The source of contamination is a spill and/or leak in pipe fittings on the diesel tank.

Migration of contaminants from the site appears to be minimal. Samples collected at the edge of the gravel pad were near non-detect indicating the tundra adjoining the gravel pad has not been impacted by the migration of contaminants.

The risk assessment concluded that risks posed to human health and ecological receptors by site contaminants are minimal given current site uses. The potential human health risks at the site are not of a magnitude that normally requires remedial action. Based on RI sampling and analyses, risk assessment and current site uses, remedial actions are not warranted at the site. Chemicals detected at the site did not pose significant human health or ecological risks; therefore, the Weather Station Building (SS15) site is recommended for no further action.



LEGEND

▭	BUILDINGS, STRUCTURES
▲	SOIL SAMPLE
⩚	TUNDRA
——	GRAVEL PAD BOUNDARY
⇾	SURFACE DRAINAGE
2.6 ppm	CT&E DATA
0.9 ppm	F&B DATA
0000	CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND	NO CONTAMINATION DETECTED
VOC	TOTAL VOLATILE ORGANIC COMPOUNDS
GRPH	GASOLINE RANGE PETROLEUM HYDROCARBONS
DRPH	DIESEL RANGE PETROLEUM HYDROCARBONS
BTEX	TOTAL BTEX COMPOUNDS

BARTER ISLAND RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 3-6

WEATHER STATION BUILDING (SS15) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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TABLE 3-9. WEATHER STATION BUILDING ANALYTICAL DATA SUMMARY

Installation: Barter Island
Site: Weather Station Building (SS15)
Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks	
					S01	S02-2	S03	S04	S05	AB01	EB01	TB01		
Laboratory Sample ID Numbers					4198-1	4198-4	4178-1 4198-5	4198-6	4198-7	4173-9 4197-6	4175-3 4203-8	4173-10 4179-7	#5-9693 #1&2-9493 4203 4175	4198 4178
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	9.55-1,150	6,100	8,420	2,090	214	107[c]	NA	<200	NA	<200-<1,000J	<4.00
GRPH	0.400	0.400	100	<0.400-<9.0	216	1,020	11.1	1.46	5.3	NA	<20	NA	<20-<50J	<0.400
BTEX (8020/ 8020 Mod.)			10 Total BTEX	<0.250-<1.500	0.459	3.567	0.154	0.023	0.547					
Benzene	0.020	0.020	0.5	<0.020-<0.300	<0.020	<0.020	<0.020	<0.020	<0.020	<1	<1	<1	<1	<0.020
Toluene	0.020	0.020		<0.020-<0.300	<0.020	0.137	<0.020	<0.020	<0.020	1.2	<1	<1	<1	<0.020
Ethylbenzene	0.020	0.020		<0.020-<0.300	0.196	1.09	0.056	<0.020	0.071	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.040		<0.040-<0.600	0.263	2.34	0.098	0.023[d]	0.476	<2	<2	<2	<2	<0.040
VOC 8260														
Naphthalene	0.020	0.020		<0.025-<0.500	NA	NA	0.083	NA	NA	<1	<1J	<1	<1	<0.020
1,3,5-Trimethylbenzene	0.020	0.020		<0.025-<0.500	NA	NA	0.084	NA	NA	<1	<1J	<1	<1	<0.020
Xylenes (Total)	0.020	0.020		<0.050-<1.000	NA	NA	0.079	NA	NA	<2	<2J	<2	<2	<0.040

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.
a The action level for DRPH is based on conversations with ADEC; a final action level has not yet been determined.
c The laboratory reported that 6.39 mg/kg of the EPH pattern in this sample was not consistent with a middle distillate fuel.
d Result is indicative of p & m xylenes only.

TABLE 3-9. WEATHER STATION ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Weather Station Building (SS15)
Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks			Lab Blanks	
					2S06	2S07-2	2S08-2	AB01	EB06	TB01		
Laboratory Sample ID Numbers					1682	1684	1686	4173-9 4197-6	1688 1690	4173-10 4179-7	#5-9693 #1&2-9493 4203 4175	#3&4-9693 4198
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-6	50-60	500[a]	9.55-1,150	<50J[b]	<50J[b]	<60J[b]	NA	<1,000J[b]	NA	<200-<1,000J	<4.00
GRPH	0.2	2	100	<0.400-<9.0	<2J[b]	4J[b]	<2J[b]	NA	<50J[b]	NA	<20-<50J	<0.400-<2J
RRPH (Approx.)	10-12	100-120	2,000[a]	<480	<100	<100	<120	NA	<2,000	NA	<2,000	NA
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.10	0.3J	<0.10					
Benzene	0.002-0.020	0.02	0.5	<0.020-<0.300	<0.02	<0.02	<0.02	<1	<1	<1	<1	<0.020
Toluene	0.002-0.020	0.02		<0.020-<0.300	<0.02	<0.02	<0.02	1.2	<4J	<1	<1	<0.020
Ethylbenzene	0.002-0.020	0.02		<0.020-<0.300	<0.02	0.1J	<0.02	<1	<2J	<1	<1	<0.020
Xylenes (Total)	0.004-0.040	0.04		<0.040-<0.600	<0.04	0.2J	<0.04	<2	<5J	<2	<2	<0.040

□ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE 3-10. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE WEATHER STATION BUILDING (SS15)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a]		ARAR[b]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Weather Station Building (SS15)	Soil	DRPH	8,420	mg/kg	9.55-1,150	--	--	500[c]	**YES**
		GRPH	1,020	mg/kg	<0.400-<9	--	--	100[c]	**YES**
		Ethylbenzene	1.09	mg/kg	<0.020-<0.500	--	2,700	--	NO
		Naphthalene	0.083	mg/kg	<0.025-<3.50	--	100	--	NO
		Toluene	0.137	mg/kg	<0.020-<0.500	--	5,400	--	NO
		1,3,5-Trimethylbenzene	0.084	mg/kg	<0.025-<0.500	--	--	--	NO
		Xylenes	2.34	mg/kg	<0.040-<1.000	--	54,000	--	NO

a Risk-Based Screening Level.
b Applicable or Relevant and Appropriate Requirement.
c ADEC 1991.

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3.6 POL TANKS (ST17)

3.6.1 Site Background

The POL Tanks (ST17) site, a bulk fuel storage area for arctic grade diesel fuels, is located north of the module trains and south of the sewage lagoon. The site consists of six large, approximately 200,000 gallon, above-ground tanks and associated piping and pumphouse, each contained inside a currently lined berm. The POL Tanks site had been closed, but is being investigated as a possible source area of the POL Catchment (LF03).

The site-specific environmental setting describing the topography, surface water drainage, and soil types is presented in the discussion of potential migration pathways, Section 3.6.3.

3.6.2 Field Sampling and Analytical Results

This section describes the RI sampling and analytical results for samples collected at the POL Tanks (ST17) site. The discussion presents a review of laboratory data, data summary tables, contaminants identified, contaminant trends, and information on suspected source areas.

3.6.2.1 Summary of Samples Collected. A total of four soil samples was collected from drainage pathways and possible contaminant migration routes the from the POL Tanks site. Table 2-2 presents a detailed summary of the samples collected and analyses performed during the 1993 RI field activities. Locations of all samples collected at the POL Tanks (ST17) site and a summary of analytical results above background levels are presented in Figure 3-7.

The four soil samples collected at this site were analyzed for DRPH, GRPH,RRPH, and BTEX. In addition, one sample was analyzed for VOCs and SVOCs.

3.6.2.2 Analytical Results. The data summary table (Table 3-11) presents analytical results for all samples collected at the site. Detection and quantitation limits, action levels, associated laboratory and field blanks, and background analytical results are presented for each of the analyses. Background levels are listed to allow direct comparison of naturally occurring organic compounds with samples collected from the site. Sample locations and analytical results for the samples at the site are illustrated in Figure 3-7. All organic compounds detected are presented on the figure except when they were a result of laboratory contamination or field decontamination procedures. The exceptions are presented on the data summary table. The following sections present a discussion of organic compounds detected at the site.

Organics. Organic compounds detected in soil samples collected at the site include DRPH, GRPH, BTEX, and one other VOC. DRPH were detected in two samples at 540 and 1,670 mg/kg (ST17-S03 and ST17-S04/S06). GRPH were detected in the same two soil samples at 295 and 65 mg/kg. BTEX compounds were detected in two samples. Total BTEX was detected at 1.0 mg/kg in both soil samples ST17-S03 and ST17-S04/S06. One other VOC (1,2,4-trimethylbenzene, a common component of diesel fuel) was detected in soil sample ST17-S04/S06 at 0.511 mg/kg.

Inorganics. Metals were not a concern at the site, and no inorganic analyses were performed.

3.6.2.3 Summary of Site Contamination. DRPH were detected in two soil samples associated with the POL Tanks (ST17) site. However, these samples were collected on a beach area of active sewage lagoon. Because the POL Tanks site and the sewage lagoon are active compliance sites, ADEC and the Air Force have recommended that the POL Tanks site be discontinued from the IRP investigation. No previous sampling has been conducted at the site. The human health and ecological risks associated with the chemicals detected at the site are presented in Sections 3.6.4 and 3.6.5.

3.6.3 Migration Pathways

This section describes the topography and stratigraphy of the site and the migration potential of contaminants from the site. A discussion of receptors and chemical concentrations at receptors is included.

3.6.3.1 Topography and Stratigraphy. Topography at the site consists of gravel berms placed upon relatively flat tundra (Figure 3-7). Berms surrounding the POL Tanks reach a maximum height of 12 feet, and are steeply graded down to the land surface. A system of culverts has been installed to drain runoff from the bermed areas. Runoff is channeled to the east, where it enters the POL Catchment (LF03) area. The site is separated from the active sewage lagoon to the north by a berm road.

During the 1993 RI, the depth to permafrost at the site was approximately four feet. Subsurface materials at the site consisted of typical sands and gravels associated with gravel pads (Section 2.4.4.2).

3.6.3.2 Migration Potential.

Subsurface Migration. The berms surrounding the POL Tanks are lined; therefore, active layer water should be contained in this area. The DRPH contaminated soils are located north of the containment berms and are not likely to have been reached by spills in the containment area. Migration may have occurred several years ago before the tank farm was lined. Currently, subsurface migration is not a concern at the site.

Surface Migration. No surface water bodies were present at the site during the field investigation. Ditches and culverts at the site funnel runoff eastward, to the POL Catchment area (LF03). Petroleum contamination in surface water and sediment samples from that site indicates that this has been a surface migration pathway. Because of the low amount of precipitation in the summer months, this migration pathway is probably active principally during the spring thaw, when large amounts of runoff in the form of meltwater are available.

Air Transport. Air transportation is not expected to be a significant mode of migration at the site (Section 2.4.4.5).

Summary of Migration Potential. Surface runoff from the site has contaminated the adjacent POL Catchment area. The amount of contaminant migration was probably greatest at the time of the spill and in the spring, when large quantities of meltwater are available. Currently, there is no apparent contamination at the POL Tanks and surface migration of contaminants is probably not occurring. Analytical data suggest that subsurface and/or surface migration may have occurred to the north, but because the berm here has been retrofitted with a lining this is probably not an active pathway.

3.6.3.3 Receptors and Chemical Concentrations at Receptors.

Human Receptors. Potential human receptors at the POL Tanks site include Air Force contractor personnel working at the station, visitors to the station, and an occasional local visitor passing the site to get to recreational or subsistence lands. Human receptors could potentially be exposed to the chemicals detected in soil/sediment at the site. The primary routes of potential exposures at the site are direct contact with, and incidental ingestion of, soil/sediment. Surface water was not considered a route of exposure at the site because no surface waters are associated with the site. Because groundwater and air at the Barter Island sites are not considered complete pathways of exposure, these media are not evaluated as potential pathways to human receptors.

The Barter Island Risk Assessment (U.S. Air Force 1996) evaluates in detail the risks to human health from all COCs detected at the site. The potential receptor groups were selected based on their likelihood of exposure to contaminants at the site, and include DEW Line workers at the installation, and native adults and children who may visit the site. The estimated exposure point concentrations for human receptors are based on the maximum concentration of each chemical detected at the site. The potential risks to human health associated with site chemicals at Barter island are presented in Section 3.6.4.

Ecological Receptors. Ecological receptors were evaluated in detail in the Barter Island Risk Assessment (U.S. Air Force 1996) to determine if plants and animals could potentially be impacted by the chemicals detected at the Barter Island installation. Because of the diversity of the plants and animals in the area of the Barter Island installation, a set of representative species was selected in the ERA for detailed evaluation. The species include plants, aquatic invertebrates, fish, birds, and mammals. These receptors were selected based on the species' likelihood of exposure given their preferred habitat and feeding habits. The representative species encompass a range of ecological niches in order to achieve the best characterization of the ecosystems being examined and are presented in Table 2-6.

The estimate of chemical concentrations at the ecological receptors was based on the average site-wide concentration of each COC. This approach was appropriate because few of the representative species would inhabit only one distinct site at the installation; they are more likely to be exposed to the mix of chemicals and concentrations detected on all the sites at Barter Island. The potential ecological risks associated with the chemicals detected at the site are presented in Section 3.6.5.

3.6.4 Human Health Risk Assessment

This section presents a summary of the potential human health risks associated with the chemicals detected at the POL Tanks (ST17) site. The purpose of the human health risk assessment is to quantify the excess lifetime cancer risk and/or the noncancer hazard (reported as hazard index) from the contaminants detected at the site.

This summary presents the COCs at the site, the pathways by which human receptors may be exposed to site chemicals, potential risks to human health posed by each chemical through each exposure pathway, the significance of the risk and/or hazard estimate, and a comparison of site chemical concentrations to ARARs. The methods and assumptions used in calculating hazards and risks are presented in Section 2.4.1.

3.6.4.1 Chemicals of Concern. At the POL Tanks (ST17), COCs identified in the soil/sediment at the site included DRPH and GRPH. These COCs were both selected because the maximum concentrations detected exceeded ARARs. No surface water bodies were associated with the site; therefore, no surface water samples were collected.

Table 3-12, Identification of COCs at the POL Tanks, presents the maximum concentrations of chemicals detected at the site and the associated background concentrations, RBSLs, and ARARs, and identifies the COCs selected in the risk evaluation.

3.6.4.2 Exposure Pathways and Potential Receptors. The ingestion of soil/sediment was considered an exposure pathway at the site. No surface water bodies were associated with the POL Tank site; therefore, no evaluation of risk or hazard was conducted for water ingestion.

Three potential receptor groups were evaluated in the risk assessment: an adult assigned to a DEW Line installation (worker), an adult inhabitant of communities in the North Slope of Alaska (native), and a child living in a North Slope community (child).

3.6.4.3 Risk Characterization.

Noncancer Hazard and Cancer Risk Associated with Soils and Sediments. The noncancer hazard associated with the ingestion of soil at the POL Tanks (ST17) site by a hypothetical native northern adult/child is 0.027, and by a DEW Line worker is 0.001, based on the maximum concentrations of the COCs. The presence of DRPH and GRPH accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations. The excess lifetime cancer risk associated with the ingestion of soil at the site by a hypothetical native northern adult/child is 9×10^{-8}, and by a DEW Line worker is 4×10^{-9}, based on the maximum concentration of the COC. The presence of GRPH accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

Noncancer Hazard and Cancer Risk Associated with Surface Water. No surface water bodies were identified at the POL Tanks (ST17). Therefore, there is no apparent surface water pathway, and no evaluation of noncancer hazard or excess lifetime cancer risk associated with ingestion of surface water at the site was conducted.

3.6.4.4 **Summary of Human Health Risk Assessment**. The potential risks and hazards associated with the soil/sediment at the POL Tanks are the very low noncancer hazards (hazard indices of 0.001 and 0.027) and very low cancer risks ($<10^{-7}$) associated with the DRPH and GRPH detected at the site. The noncancer hazards and carcinogenic risks are significantly below regulatory threshold values. In addition these hazards and risks were calculated conservatively based on maximum concentrations detected and using a residential scenario. Therefore, the noncancer hazards and carcinogenic risks associated with soil/sediment at the site are minimal.

In conclusion, under current uses the COCs identified in soil/sediment at the POL Tank site pose only a minimal, if any, potential threat to human health. Based on the human health risk assessment, remedial actions are not warranted at the site.

3.6.5 Ecological Risk Assessment

The objective of the ERA is to estimate the potential impacts of chemicals detected at the installation to aquatic and terrestrial plants and animals. A summary of the methods used to assess potential ecological impacts is presented in Section 2.4.2.

3.6.5.1 **Chemicals of Concern**. COCs were selected based on the average installation-wide concentration of chemicals detected at the Barter Island sites. Only sites where useable habitat exists and that were likely used by ecological receptors were included in the ecological risk evaluation. The POL Tanks (ST17) site does not consist of usable habitat for ecological receptors because the contaminated portion of the site consists only of a very limited area of gravel pad.

Because the site was determined not to be suitable habitat, no exposure pathways or potential receptors were evaluated for the POL Tanks (ST17) site.

3.6.5.2 **Summary of Ecological Risk Assessment**. The POL Tanks site was not evaluated in the ERA because it did not provide suitable habitat for potential ecological receptors. Exposures to COCs of the representative species at this site were not expected. In addition, the potential risks presented by the chemicals detected at the site were evaluated at other sites, and potential ecological risks were determined to be minimal.

3.6.6 Conclusions and Recommendations

Sampling and analyses have determined that the POL Tanks (ST17) site is not significantly contaminated. Petroleum hydrocarbons and BTEX compounds were detected in two sediment samples collected north of the POL Tanks below the high water mark of the sewage lagoon. The chemicals detected are possibly associated with the past disposal practices at the sewage lagoon. For many years the sewage lagoon received wastes from the radar installation and the village of Kaktovik. No contaminants were detected in other samples collected from the site and there were no visual signs of spills or leaks in the active tank farm area.

The risk assessment concluded that risks posed to human health and ecological receptors by site contaminants are minimal given current or future site uses. Based on the RI sampling and analyses, risk assessment, and current site uses, remedial actions are not warranted at the site.

Both the POL Tanks and the sewage lagoon are active compliance sites, and ADEC has recommended that the POL Tank site be removed from the list of IRP sites at this installation. Any future spills or leaks from the site will be handled as compliance issues. Therefore, the POL Tanks (ST17) site is recommended for no further action.

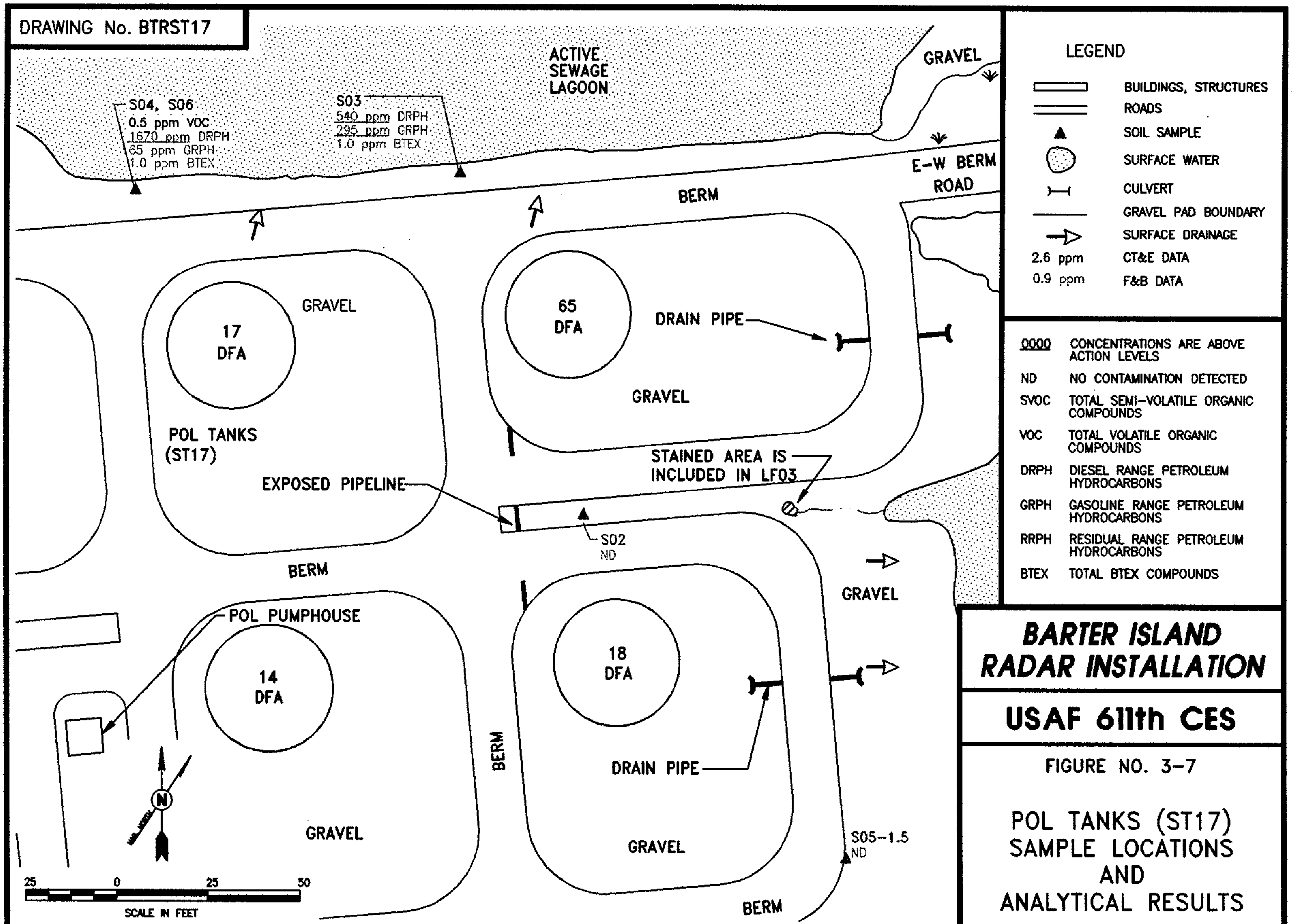

FIGURE NO. 3-7

POL TANKS (ST17) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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TABLE 3-11. POL TANKS ANALYTICAL DATA SUMMARY

Installation: Barter Island
Site: POL Tanks (ST17)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks	
					S02	S03	S04 & (Replicates)	S06	S05-1.5	AB02	EB04	TB04		
Laboratory Sample ID Numbers					1292	1294	1296 4302-4	1300 4302-5	1298	315 4303-1	311 4302-10	1346 4302-9	#3&4-82493 #3&4-83193 4303 4302	#6-83193 #1&2-83193 4302
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	8	80	500[a]	9.55-1,150	<80[b]	540[b]	730[b]	1,670[b]	<80[b]	NA	NA	NA	NA	<70J
GRPH	0.2-0.4	2-4	100	<0.400-<9.0	<2J[b]	295J[b]	52J[b]	65J[b]	<4J[b]	<100J[b]	<100J[b]	<100J[b]	<100J	<2J
RRPH (Approx.)	10-30	100-300	2,000[a]	<480	<100	<300	<100	<140	<120	NA	NA	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.10	1.0	0.4J	1.0J	<0.35					
Benzene	0.002-0.006	0.02-0.06	0.5	<0.020-<0.300	<0.02	<0.06	<0.03	<0.02	<0.03	<1	<1	<1	<1	<0.02
Toluene	0.002-0.006	0.02-0.06		<0.020-<0.300	<0.02	1.0	<0.03	<0.02	<0.06	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002-0.006	0.02-0.06		<0.020-<0.300	<0.02	<0.02	0.1	0.4	<0.06	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004-0.020	0.04-0.2		<0.040-<0.600	<0.04	<0.04	0.3J	0.8J	<0.2	<2	<2	<2	<2	<0.04
VOC 8260														
1,2,4-Trimethylbenzene	0.020	0.240-0.250		<0.025-<0.500	NA	NA	0.511	0.344	NA	<1	<1	<1	<1	<0.020
SVOC 8270	0.200	2.30-2.50		<0.23-<3.5	NA	NA	<2.50	<2.30	NA	NA	<25-75	NA	<10	<0.200

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE 3-12. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE POL TANKS (ST17)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a]		ARAR[b]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
POL Tanks (ST17)	Soil	DRPH	1,670	mg/kg	9.55-1,150	--	--	500[c]	YES
		GRPH	295	mg/kg	<0.400-<9	--	--	100[c]	YES
		Ethylbenzene	0.4	mg/kg	<0.020-<0.500	--	2,700	--	NO
		Toluene	1.0	mg/kg	<0.020-<0.500	--	5,400	--	NO
		1,2,4-Trimethylbenzene	0.511	mg/kg	<0.025-<0.500	--	--	--	NO
		Xylenes	0.6	mg/kg	<0.040-<1.000	--	54,000	--	NO

a Risk-Based Screening Level.
b Applicable or Relevant and Appropriate Requirement.
c ADEC 1991.

3.7 FUEL TANKS (ST18)

3.7.1 Site Background

The Fuel Tanks (ST18) site is an active tank farm located inside a lined berm approximately 300 feet east of module train B. The Fuel Tanks consist of six 10,000 gallon above-ground tanks that contain vehicle fuel. Four tanks contain MOGAS and two tanks contain diesel. The tanks are used to fuel vehicles and heavy equipment used at the station. Site personnel indicated the possibility of a previous fuel spill in this area.

The site specific environmental setting describing the topography, surface water drainage, and soil types is presented in the discussion of potential migration pathways, Section 3.7.3.

3.7.2 Field Sampling and Analytical Results

This section describes RI sampling and analytical results for samples collected at the Fuel Tanks site. The discussion presents a review of laboratory data, data summary tables, contaminants identified, contaminant trends, and information on suspected source areas.

3.7.2.1 Summary of Samples Collected. A total of 13 samples was collected at the site. These consisted of 11 soil samples, 1 sediment sample, and 1 surface water sample. Table 2-2 presents a detailed summary of the samples collected and the analyses performed during the 1993 RI field activities. Locations of all samples collected at the Fuel Tanks (ST18) site and a summary of analytical results above background levels are presented in Figure 3-8.

Eleven soil samples were analyzed for DRPH and RRPH. In addition, ten samples were analyzed for GRPH and BTEX. Two samples were analyzed for VOCs and SVOCs, and one sample was analyzed for TOC.

One sediment sample was analyzed for DRPH, GRPH, RRPH, BTEX, VOCs, SVOCs, and TOC.

One surface water sample was analyzed for GRPH, BTEX, VOCs, SVOCs, TDS, TSS, and TOC.

3.7.2.2 Analytical Results. The data summary table (Table 3-13) presents analytical results for all samples collected at the site. Detection and quantification limits, action levels, associated laboratory and field blanks, and background analytical results are presented for each of the analyses. Background levels are listed to allow direct comparison of naturally occurring organic compounds with the samples collected from the site. Sample locations for the Fuel Tanks site are illustrated in Figure 3-8. All organic compounds detected are presented on the figure except when they were a result of laboratory contamination or field decontamination procedures. These exceptions are presented on the data summary table.

The following section presents a discussion of organic compounds detected at the site. A discussion of TDS, TSS, and TOC is included.

Organics. Organic compounds detected in soil and sediment samples collected at the site include DRPH, GRPH, RRPH, BTEX, and two other VOCs. DRPH and GRPH were detected in soil sample ST18-2S11-2 at 490 and 6 mg/kg, respectively. RRPH were detected in one soil sample, ST18-S06, at 190 mg/kg. BTEX compounds were detected at very low concentrations in two samples; total BTEX was detected at 0.211 and 0.8 mg/kg. Two other VOCs, both components of diesel fuel, were detected in soil sample ST18-S02 at 0.128 and 0.048 mg/kg.

In the surface water sample, no organic compounds were detected.

Inorganics. Metals were not a concern at the site, so no metals analyses were performed. TOC in soil/sediment samples was reported at 1,300 and 3,400 mg/kg (ST18-S02 and ST18-SD01, respectively). TOC, TDS, and TSS were reported in surface water sample ST18-SW01 at 36,300; 711,000; and 8,000 μg/L, respectively.

3.7.2.3 Summary of Site Contamination. The contamination at the site appears to be from diesel fuel as DRPH was the primary constituent detected. The extent of the DRPH at the Fuel Tanks (ST18) site is suspected to be limited to a small area to the north of the bermed tank farm, as diesel was not detected in surrounding samples. The contamination may have been caused by leaks or spills while filling equipment, or from leaking vehicles parked on the pad. No previous sampling has been conducted at the site. The human health and ecological health risks associated with the chemicals detected at the site are presented in Sections 3.7.4 and 3.7.5.

3.7.3 Migration Pathways

This section describes the topography and stratigraphy of the site and the migration potential of contaminants from the site. A discussion of receptors and chemical concentrations at receptors is included.

3.7.3.1 Topography and Stratigraphy. The topography in this area consists of a gravel pad placed on relatively flat tundra (Figure 3-8). The tundra to the south of the tank farm is marshy with numerous small ponds. Surface drainage is radially out from the site and into the tundra to the south and gravel pad areas to the north. Fifty feet west of the site is a small surface drainage that leads to the Contaminated Ditch (SD08). The Fuel Tanks are surrounded by a low berm which is approximately two and a half feet in height. Three culverts lead south out of this berm into the tundra.

During the 1993 RI, permafrost was located at a depth of approximately two and a half feet in tundra areas and four feet under gravel pads. Gravel pad materials consisted of typical gravels and sands associated with these features, and subsurface tundra materials were typical of the stratigraphy found at Barter Island (Section 2.4.4.2).

3.7.3.2 Migration Potential.

Subsurface Migration. The topography at the site indicates that any subsurface flow should be radially away from the Fuel Tanks. Subsurface migration is not considered significant at the site because significant concentrations of contaminants were not detected in subsurface soil samples.

Surface Migration. There are no distinct surface drainage features in the immediate vicinity of the site. The Fuel Tanks site is drained by three culverts into the marshy tundra to the south. Surface soil and water samples in this area contained relatively low concentrations of contaminants, indicating that little surface migration has occurred.

Air Transport. Air transportation is not considered to be a significant mode of migration at the site (Section 2.4.4.5).

Summary of Migration Potential. Analytical data suggest that petroleum compounds are present at relatively low concentrations and in only a few locations at the site. Because of the flat topography and the lack of distinct drainage features, the potential for contaminant migration is considered to be low.

3.7.3.3 Receptors and Chemical Concentrations at Receptors.

Human Receptors. Potential human receptors at the Fuel Tanks site include Air Force contractor personnel working at the station, visitors to the station, and an occasional local visitor passing the site to get to recreational or subsistence lands. Human receptors could potentially be exposed to the chemicals detected in soils/sediments at the site. The primary routes of potential exposures at the site are direct contact with, and incidental ingestion of, soil/sediment. Surface water was not considered a route of exposure at the site because no surface waters are associated with the site. Because groundwater and air at the Barter Island sites are not considered complete pathways of exposure, these media are not evaluated as potential pathways to human receptors.

The Barter Island Risk Assessment (U.S. Air Force 1996) evaluates in detail the risks to human health from all COCs detected at the site. The potential receptor groups were selected based on their likelihood of exposure to contaminants at the site, and include DEW Line workers at the installation, and native adults and children who may visit the site. The estimated exposure point concentrations for human receptors are based on the maximum concentration of each chemical detected at the site. The potential risks to human health associated with site chemicals at Barter Island are presented in Section 3.6.4.

Ecological Receptors. Ecological receptors were evaluated in detail in the Barter Island Risk Assessment (U.S. Air Force 1996) to determine if plants and animals could potentially be impacted by the chemicals detected at the Barter Island installation. Because of the diversity of the plants and animals in the area of the Barter Island installation, a set of representative species was selected in the ERA for detailed evaluation. The species include plants, aquatic invertebrates, fish, birds, and mammals. These receptors were selected based on the species' likelihood of exposure given their preferred habitat and the habits. The representative species encompass a range of ecological niches in order to achieve the best characterization of the ecosystems being examined and are presented in Table 2-6.

The estimate of chemical concentrations at the ecological receptors was based on the average site-wide concentration of each COC. This approach was appropriate because few of the representative species would inhabit only one distinct site at the installation; they are more likely

to be exposed to the mix of chemicals and concentrations detected on all the sites at Barter Island. The potential ecological risks associated with the chemicals detected at the site are presented in Section 3.7.5.

3.7.4 Human Health Risk Assessment

This section presents a summary of the potential human health risks associated with the chemicals detected at the Fuel Tanks (ST18) site. The purpose of the human health risk assessment is to quantify the excess lifetime cancer risk and/or the noncancer hazard (reported as hazard index) from the contaminants detected at the site.

This summary presents the COCs at the site, the pathways by which human receptors may be exposed to site chemicals, potential risks to human health posed by each chemical through each exposure pathway, the significance of the risk and/or hazard estimate, and a comparison of site chemical concentrations to ARARs. The methods and assumptions used in calculating hazards and risks are presented in Section 2.4.1.

3.7.4.1 Chemicals of Concern. At the Fuel Tanks (ST18), no COCs were identified for the soil/sediment or surface water at the site. No organic constituents were detected in samples from the site, and no metal concentrations were above background levels, RBSL, or ARARs. Therefore, there appears to be no potential risk and/or hazard to human health from chemicals detected at the site.

Table 3-14, Identification of COCs at the Fuel Tanks, presents the maximum concentrations of chemicals detected at the site and the associated background concentrations, RBSLs, and ARARs, and identifies that no COCs were selected in the risk evaluation.

3.7.4.2 Summary of Human Health Risk Assessment. There were no COCs identified in the soil/sediment or surface water matrices at the Fuel Tanks site. Therefore, there were no COCs to evaluate. Based on the human health risk assessment, remedial actions are not warranted at the site.

3.7.5 Ecological Risk Assessment

The objective of the ERA is to estimate the potential impacts of chemicals detected at the installation to aquatic and terrestrial plants and animals. A summary of the methods used to assess potential ecological impacts is presented in Section 2.4.2.

3.7.5.1 Chemicals of Concern. COCs were selected based on criteria presented in Section 3.1 of the ERA. No COCs were detected in surface water, and the COCs detected in soil/sediment were DRPH, ethylbenzene, and xylenes. No COCs were associated with elevated HQs at the Fuel Tanks site.

3.7.5.2 Summary of Ecological Risk Assessment. None of the COCs detected at the Fuel Tanks site were associated with potential ecological risk.

3.7.6 Conclusions and Recommendations

Sampling and analyses have determined that there is no significant contamination at the Fuel Tanks (ST18) site. Relatively low levels of petroleum hydrocarbons were detected in only two of thirteen site samples. No contaminants were detected in surface water samples, indicating there is no migration of contaminants from the site. The sources of the low levels of petroleum hydrocarbons at the site are likely to be small incidental spills of fuel during vehicle refueling operations.

The risk assessment concluded that no COCs were present at the site; therefore, no evaluation of risk was conducted. Other sites with higher concentrations of the same chemicals detected, however, were evaluated and determined not to pose a risk to human health or the environment.

Based on the RI sampling and analyses, risk assessment, and current site uses, remedial actions are not warranted at the site. The Fuel Tanks is an active compliance site and ADEC has recommended that the Fuel Tanks site be removed from the list of IRP sites at this installation. Any future spills or leaks from the site will be handled as compliance issues. Therefore, the Fuel Tanks (ST18) site is recommended for no further action.

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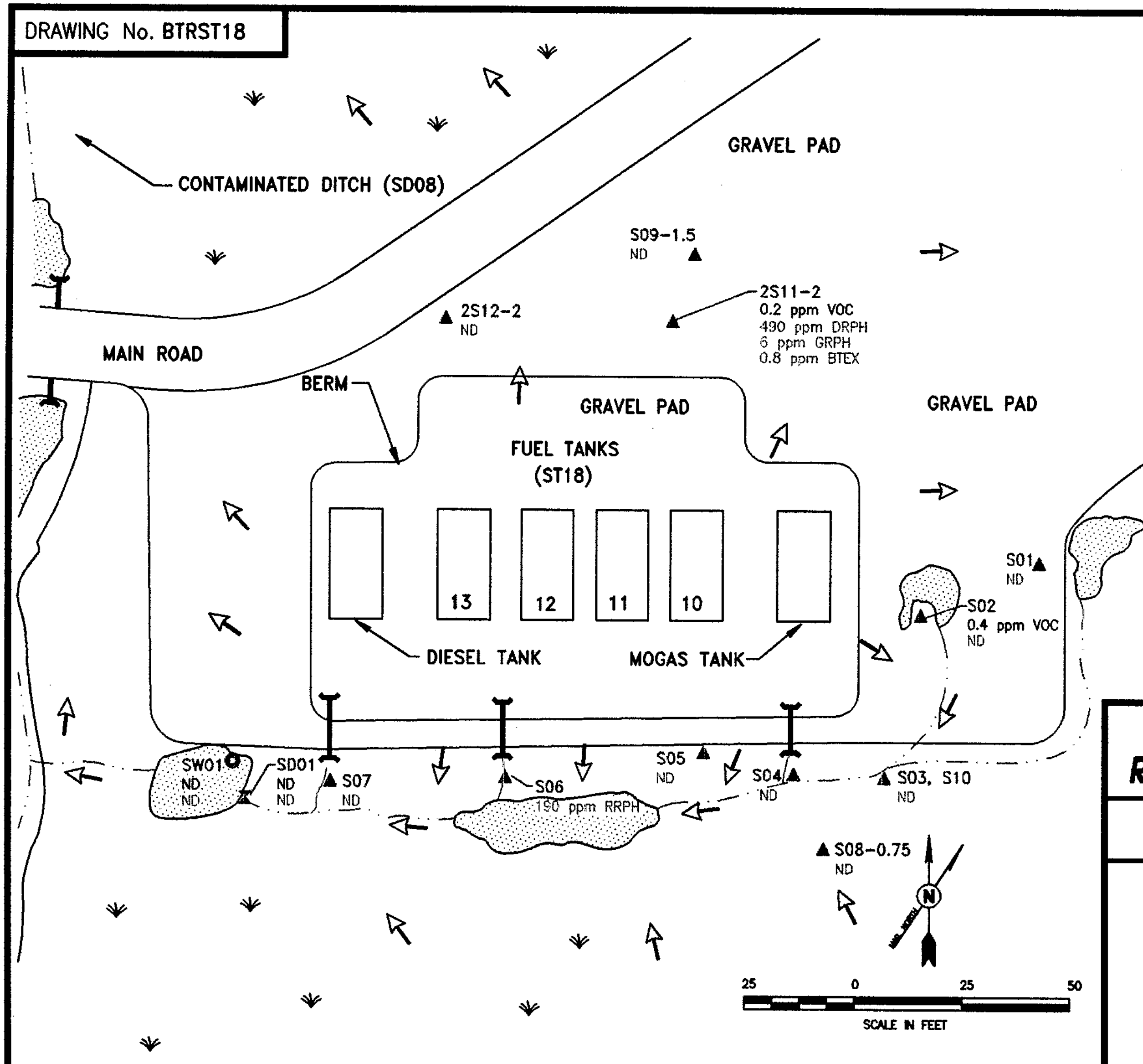

BARTER ISLAND RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 3-8

FUEL TANKS (ST18) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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TABLE 3-13. FUEL TANKS ANALYTICAL DATA SUMMARY

Installation: Barter Island
Site: Fuel Tanks (ST18)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples S01	S02	S03 & (Replicates)	S10	S04	S05	S06	S07	Field Blanks AB02	EB04	TB04	Lab Blanks	
Laboratory Sample ID Numbers					1302	1304 4302-7	1306	1308	1310	1312	1314	1322	315 4303-1	311 4302-10	1346 4301-9	#3&4-82493 #3&4-83192 4303 4302 4301	#1&2-83193 #6-83193 4302
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-10	50-100	500[a]	9.55-1,150	<80[b]	<70[b]	<80[b]	<80[b]	<100[b]	<80[b]	<50[b]	<70[b]	NA	NA	NA	NA	<70J
GRPH	0.2	2	100	<0.400-<9.0	<2J[b]	<2J[b]	<2J[b]	<2J[b]	<2J[b]	<2J[b]	<2J[b]	<2J[b]	<100J[b]	<100J[b]	<100J[b]	<50J-<100J	<2J
RRPH (Approx.)	10-11	100-110	2,000[a]	<480	<100	<100	<100	<100	<100	<100	190	<110	NA	NA	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10					
Benzene	0.002	0.02	0.5	<0.020-<0.300	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<1	<1	<1	<1	<0.02
Toluene	0.002	0.02		<0.020-<0.300	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002	0.02		<0.020-<0.300	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004	0.04		<0.040-<0.600	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<2	<2	<2	<2	<0.04
VOC 8260																	
Ethylbenzene	0.020	0.020		<0.025-<0.500	NA	0.020	NA	NA	NA	NA	NA	NA	<1	<1	<1	<1	<0.020
1,2,4-Trimethylbenzene	0.020	0.020		<0.025-<0.500	NA	0.128	NA	NA	NA	NA	NA	NA	<1	<1	<1	<1	<0.020
1,3,5-Trimethylbenzene	0.020	0.020		<0.025-<0.500	NA	0.048	NA	NA	NA	NA	NA	NA	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.040	10	<0.500-<1.00	NA	0.191	NA	NA	NA	NA	NA	NA	<2	<2	<2	<2	<0.040
SVOC	0.200	0.220		<0.230-<3.50	NA	<0.220	NA	NA	NA	NA	NA	NA	NA	<25-75	NA	<10	<0.200
TOC				32,000-199,000	NA	1,330	NA	NA	NA	NA	NA	NA	NA	<5,000	NA	<5,000	NA

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE 3-13. FUEL TANKS ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Fuel Tanks (ST18)

Matrix: Soil/Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks				Lab Blanks	
					S08-0.75	S09-1.5	2S11-2	2S12-2	SD01	AB02	EB04	EB08	TB04		
Laboratory Sample ID Numbers					1316	1318	1754 4616-6	1752	1320 4302-6	315 4303-1	311 4302-10	1719 1720 4616-13	1346 4302-9	#3&4-83193 #3&4-82493 #1&2-9693 #5-9693 4616 4303 4302	#1&2-83193 #6-83193 4616 4302
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-10	50-100	500[a]	9.55-1,150	<100[b]	<80[b]	490[b]	<50[b]	<70[b]	NA	NA	<1,000J[b]	NA	<1,000J	<70J
GRPH	0.1-0.2	1-2	100	<0.400-<9.0	NA	<2J[b]	6J[b]	<1J[b]	<2J[b]	<100J[b]	<100J[b]	<50J[b]	<100J[b]	<50J-<100J	<2J
RRPH (Approx.)	10-15	100-150	2,000[a]	<480	<150	<100	<100	<100	<110	NA	NA	<2,000	NA	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	NA	<0.10	0.8J	<0.10	<0.10						
Benzene	0.002	0.02	0.5	<0.020-<0.300	NA	<0.02	0.1J	<0.02	<0.02	<1	<1	<1	<1	<1	<0.02
Toluene	0.002	0.02		<0.020-<0.300	NA	<0.02	0.1	<0.02	<0.02	<1	<1	<1J	<1	<1	<0.02
Ethylbenzene	0.002	0.02		<0.020-<0.300	NA	<0.02	0.2	<0.02	<0.02	<1	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004	0.04		<0.040-<0.600	NA	<0.04	0.4J	<0.04	<0.04	<2	<2	<2	<2	<2	<0.04
VOC 8260															
Benzene	0.020	0.020	0.5	<0.025-<0.500	NA	NA	0.091	NA	<0.020	<1	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.020	0.040		<0.050-<1.000	NA	NA	0.063	NA	<0.040	<2	<2	<2	<2	<2	<0.040
SVOC 8270	0.20	<0.210-0.214		<0.230-<3.50	NA	NA	<0.214-<1.67	NA	<0.210	NA	<25-75	NA	NA	<10	<0.200
TOC				32,000-199,000	NA	NA	NA	NA	3,400	NA	<5,000	NA	NA	<5,000	NA

□ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE 3-13. FUEL TANKS ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Surface Water
Site: Fuel Tanks (ST18) Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Sample					Field Blanks			Lab Blanks
					SW01					AB02	EB04	TB04	
Laboratory Sample ID Numbers					317 4302-8					315 4303-1	311 4302-10	1346 4302-9	#3&4-83193 #3&4-82493 4303 4302
ANALYSES	µg/L	µg.L	µg/L	µg/L	µg/L					µg/L	µg/L	µg/L	µg/L
GRPH	10	100		<20	<100J[b]					<100J[b]	<100J[b]	<100J[b]	<100J
BTEX (8020/8020 Mod.)													
Benzene	0.1	1	5	<1	<1					<1	<1	<1	<1
Toluene	0.1	1	1,000	<1	<1					<1	<1	<1	<1
Ethylbenzene	0.1	1	700	<1	<1					<1	<1	<1	<1
Xylenes (Total)	0.2	2	10,000	<2	<2					<2	<2	<2	<2
VOC 8260	1	1		<1-3.2B	<1-3U					<1-6.3	<1-6.0	<1	<1
SVOC 8270	10	10		<10	<10					NA	<25-75	NA	<10
TOC	5,000	5,000		<5,000-12,700	36,300					NA	<5,000	NA	<5,000
TSS	100	200		<30,000-8,000	8,000J					NA	NA	NA	<200
TDS	10,000	10,000		<352,000-328,000	711,000J					NA	NA	NA	12,000

☐ CT&E Data.
▦ F&B Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
J Result is an estimate.
U Compound is not present above the concentration listed.
b GRPH concentrations reported for these samples are equivalent to gasoline range organics (GRO) as defined by ADEC.

TABLE 3-14. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE FUEL TANKS (ST18)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a]		ARAR[b]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Fuel Tanks (ST18)	Soil	DRPH	490	mg/kg	9.55-1,150	--	--	500[c]	NO
		GRPH	6	mg/kg	<0.400-<9	--	--	100[c]	NO
		RRPH	190	mg/kg	<480	--	--	2,000[c]	NO
		Benzene	0.1	mg/kg	<0.020-<0.500	2.2	--	0.5[c]	NO
		Ethylbenzene	0.2	mg/kg	<0.020-<0.500	--	2,700	--	NO
		Toluene	0.1	mg/kg	<0.020-<0.500	--	5,400	--	NO
		1,2,4-Trimethylbenzene	0.128	mg/kg	<0.025-<0.500	--	--	--	NO
		1,3,5-Trimethylbenzene	0.048	mg/kg	<0.025-<0.500	--	--	--	NO
		Xylenes	0.4	mg/kg	<0.040-<1.000	--	54,000	--	NO

a Risk-Based Screening Level.
b Applicable or Relevant and Appropriate Requirement.
c ADEC 1991.

3.8 OLD DUMP SITE (LF19)

3.8.1 Site Background

The Old Dump Site (LF19) site consists of several acres of mostly tundra located northeast of the module trains and east of the Contaminated Ditch. The village of Kaktovik was located at this site from 1952 to 1964. There are no obvious areas of contamination at the site, and it is uncertain whether this area was ever used as a dump site. Previous contractors reported the site was used as a storage area for materials scheduled for retrograde by sealift.

The site-specific environmental setting describing the topography, surface water drainage, and soil types is presented in the discussion of potential migration pathways, Section 3.8.3.

3.8.2 Field Sampling and Analytical Results

This section describes the RI sampling and analytical results for the Old Dump Site. The discussion presents a review of laboratory data, data summary tables, contaminants identified, contaminant trends, and information on suspected source areas.

3.8.2.1 Summary of Samples Collected. A total of 11 samples was collected at the site. These consisted of eight soil samples, two sediment samples, and one surface water sample. Table 2-2 presents a detailed summary of the samples collected and the analyses performed during the 1993 RI field activities. Locations of all samples collected at the Old Dump Site (LF19) and a summary of analytical results above background levels are presented in Figure 3-9.

The eight soil samples were analyzed for DRPH, GRPH, RRPH, BTEX, and HVOCs. In addition, five samples were analyzed for PCBs. Two samples were analyzed for VOCs, SVOCs, pesticides, and total metals, and one sample was analyzed for TOC.

Two sediment samples were analyzed for DRPH, GRPH, and RRPH. In addition, one sample was analyzed for BTEX and HVOCs.

One surface water sample was analyzed for GRPH, BTEX, HVOCs, VOCs, SVOCs, TOC, TSS, TDS, and total and dissolved metals.

3.8.2.2 Analytical Results. The data summary table (Table 3-15) presents analytical results for all samples collected at the site. Detection and quantitation limits, action levels, associated laboratory and field blanks, and background analytical results are presented for each of the analyses. Background levels are listed to allow direct comparison of naturally occurring organic compounds and inorganic analytes with samples collected from the site. Sample locations and analytical results for the samples at the site are illustrated in Figure 3-9. All organic compounds detected are presented on the figure except when they were a result of laboratory contamination or field decontamination procedures. The exceptions are presented on the data summary table. Only metals detected above background levels are presented on Figure 3-9.

The following section presents a discussion of organic compounds and inorganic analytes detected above background levels at the site. A discussion of TDS, TSS, and TOC is included.

Organics. Organic compounds detected in soil and sediment samples collected at the site include DRPH, GRPH, and RRPH. DRPH were detected in one sediment sample, LF19-SD01, at 580 mg/kg. GRPH were detected in two samples, LF19-2S06-1.5 and LF19-2SD02, at 22 and 2 mg/kg, respectively. RRPH were detected in two samples, LF19-S05-2 and LF19-SD01, at 1,600 and 5,800 mg/kg, respectively.

No organic compounds were detected in the surface water sample.

Inorganics. No metals were detected above background concentration in soil samples collected from the site.

In surface water samples, metals analyses detected five metals (barium, calcium, iron, magnesium, and potassium) above background concentrations.

TOC was reported at 4,950 mg/kg in soil sample LF19-S04. TOC, TDS, and TSS were reported at 34,600; 1,800,000; and 51,000 μg/L, respectively, in surface water sample LF19-SW01.

3.8.2.3 Summary of Site Contamination. The source of the limited DRPH and RRPH contamination at the Old Dump Site (LF19) is unknown but is probably related to former activities at the site. The contaminants detected are isolated to a small area in the southern section of the site. Contaminants were not detected in soil, sediment, or surface water samples collected in downgradient areas. No previous sampling has been conducted at the site. The human health and ecological health risks associated with chemicals detected at the site are presented in Sections 3.8.4 and 3.8.5.

3.8.3 Migration Pathways

This section describes the topography and stratigraphy of the site and the migration potential of contaminants from the site. A discussion of receptors and chemical concentrations at receptors is included.

3.8.3.1 Topography and Stratigraphy. The topography in this area is generally flat (Figure 3-9). Local relief occurs where the tributary stream approaches the Contaminated Ditch; in this area the stream rapidly incises to four feet. Elsewhere the stream remains relatively unincised. The northern edge of the site is terminated by a beach-bluff. The tundra surface here rapidly drops 15 feet to a beach. The northern portion of the site is drained by small drainage channels that are relatively unincised and spill down the face of the beach bluff to the sea. This site is predominantly tundra, and an old gravel road runs through it.

During the 1993 RI, permafrost was located at a depth of approximately two and a half feet in tundra areas and four feet under the gravel roads. Road material consisted of typical gravels and sands, and subsurface tundra materials were typical of the stratigraphy found at Barter Island (Section 2.4.4.2).

3.8.3.2 Migration Potential.

Subsurface Migration. The topography in this area indicates that the hydraulic gradient should be very slight, resulting in a slow migration of active layer water. The topography also indicates that subsurface drainage is towards the streams at the site. Subsurface migration at the site is limited because of the proximity of these downgradient streams. These streams will act as receivers of active layer water, preventing the flow of active layer water beyond the site. Contaminated active layer water that enters the streams no longer presents a potential for subsurface migration, but a potential for surface migration is created. Petroleum compounds were detected in sediment samples in a localized area of the south tributary indicating that significant active layer water contamination probably does not occur under most of the site. The topography surrounding the area dips slightly towards the tributary stream, suggesting subsurface drainage in this direction. Sediment and surface water samples collected downgradient of this area indicates that petroleum hydrocarbons are not a significant problem.

Surface Migration. The primary routes of surface migration are the tributary streams and the small drainage channels at the northern portion of the site. Analytical data suggest that contaminant migration is not occurring in the drainage channels downgradient of the site. No contaminants were detected in water samples from the southern tributary stream.

Air Transport. Air transportation is not considered to be a significant mode of migration at the site (Section 2.4.4.5).

Summary of Migration Potential. Sampling indicates the south tributary stream is not an active surface migration pathway. Based on the relatively low levels of contaminants detected, the potential for subsurface migration appears minimal.

3.8.3.3 Receptors and Contaminant Concentrations at Receptors.

Human Receptors. Potential human receptors at the Old Dump Site include Air Force contractor personnel working at the station, visitors to the station, and an occasional local visitor passing the site to get to recreational or subsistence lands. Human receptors could potentially be exposed to the chemicals detected in surface water and soil/sediments at the site. The primary routes of potential exposures at the site are direct contact with soil/sediment, incidental ingestion of soil/sediment, and ingestion of surface water. Because groundwater and air at the Barter Island sites are not considered complete pathways of exposure, these media are not evaluated as potential pathways to human receptors.

The Barter Island Risk Assessment (U.S. Air Force 1996) evaluates in detail the risks to human health from all COCs detected at the site. The potential receptor groups were selected based on their likelihood of exposure to contaminants at the site, and include DEW Line workers at the installation, and native adults and children who may visit the site. The estimated exposure point concentrations for human receptors are based on the maximum concentration of each chemical detected at the site. The potential risks to human health associated with site chemicals at Barter Island are presented in Section 3.7.4.

Ecological Receptors. Ecological receptors were evaluated in detail in the Barter Island Risk Assessment (U.S. Air Force 1996) to determine if plants and animals could potentially be impacted by the chemicals detected at the Barter Island installation. Because of the diversity of the plants and animals in the area of the Barter Island installation, a set of representative species was selected in the ERA for detailed evaluation. The species include plants, aquatic invertebrates, fish, birds, and mammals. These receptors were selected based on the species' likelihood of exposure given their preferred habitat and feeding habits. The representative species encompass a range of ecological niches in order to achieve the best characterization of the ecosystems being examined and are presented in Table 2-6.

The estimate of chemical concentrations at the ecological receptors was based on the average site-wide concentration of each COC. This approach was appropriate because few of the representative species would inhabit only one distinct site at the installation; they are more likely to be exposed to the mix of chemicals and concentrations detected on all the sites at Barter Island. The potential ecological risks associated with the chemicals detected at the site are presented in Section 3.8.5.

3.8.4 Human Health Risk Assessment

This section presents a summary of the potential human health risks associated with the chemicals detected at the Old Dump Site (LF19) site. The purpose of the human health risk assessment is to quantify the excess lifetime cancer risk and/or the noncancer hazard (reported as hazard index) from the chemicals detected at the site.

This summary presents the COCs at the site, the pathways by which human receptors may be exposed to site chemicals, potential risks to human health posed by each chemical through each exposure pathway, the significance of the risk and/or hazard estimate, and a comparison of site chemical concentrations to ARARs. The methods and assumptions used in calculating hazards and risks are presented in Section 2.4.1.

3.8.4.1 Chemicals of Concern. At the Old Dump Site (LF19), DRPH and RRPH were identified as COCs for the soil/sediment matrix. These COCs were selected because the maximum concentrations detected exceeded ARARs. No COCs were identified for surface water at the site.

Table 3-16, Identification of COCs at the Old Dump Site, presents the maximum concentrations of chemicals detected at the site and the associated background concentrations, RBSLs, and ARARs, and identifies COCs selected in the risk evaluation.

3.8.4.2 Exposure Pathways and Potential Receptors. Because no COCs were identified for surface water at the Old Dump Site, only ingestion of soil/sediment was evaluated in the risk assessment.

Three potential receptor groups were evaluated in the risk assessment: an adult assigned to a DEW Line installation (worker), an adult inhabitant of communities in the North Slope of Alaska (native), and a child living in a North Slope community (child).

3.8.4.3 Risk Characterization.

Noncancer Hazard and Cancer Risk Associated with Soils and Sediments. The noncancer hazard associated with the ingestion of soil at the Old Dump Site (LF19) by a hypothetical native northern adult/child is 0.097, and by a DEW Line worker is 0.005, based on the maximum concentrations of the COCs. The presence of RRPH accounts for more than 90 percent of the quantifiable noncancer hazard for these receptor/pathway combinations. No carcinogenic COCs were selected for the soil/sediment at the site.

Noncancer Hazard and Cancer Risk Associated with Surface Water. No COCs were identified for surface water at the Old Dump Site. The concentrations of chemicals detected in surface water were below those considered acceptable under Region 10 guidance (EPA 1991a) or ARARs.

3.8.4.4 Summary of Human Health Risk Assessment. The only risks and/or hazards associated with the Old Dump Site are the noncancer hazard indices of 0.005 and 0.097 associated with the levels of DRPH and RRPH detected in soil/sediment. There were no carcinogenic COCs identified for the site.

In conclusion, under current uses the COCs identified in soil/sediment at the Old Dump Site pose only a minimal, if any, potential threat to human health. Based on the human health risk assessment, remedial actions are not warranted at the site.

3.8.5 Ecological Risk Assessment

The objective of the ERA is to estimate the potential impacts of chemicals detected at the installation to aquatic and terrestrial plants and animals. A summary of the methods used to assess potential ecological impacts is presented in Section 2.4.2.

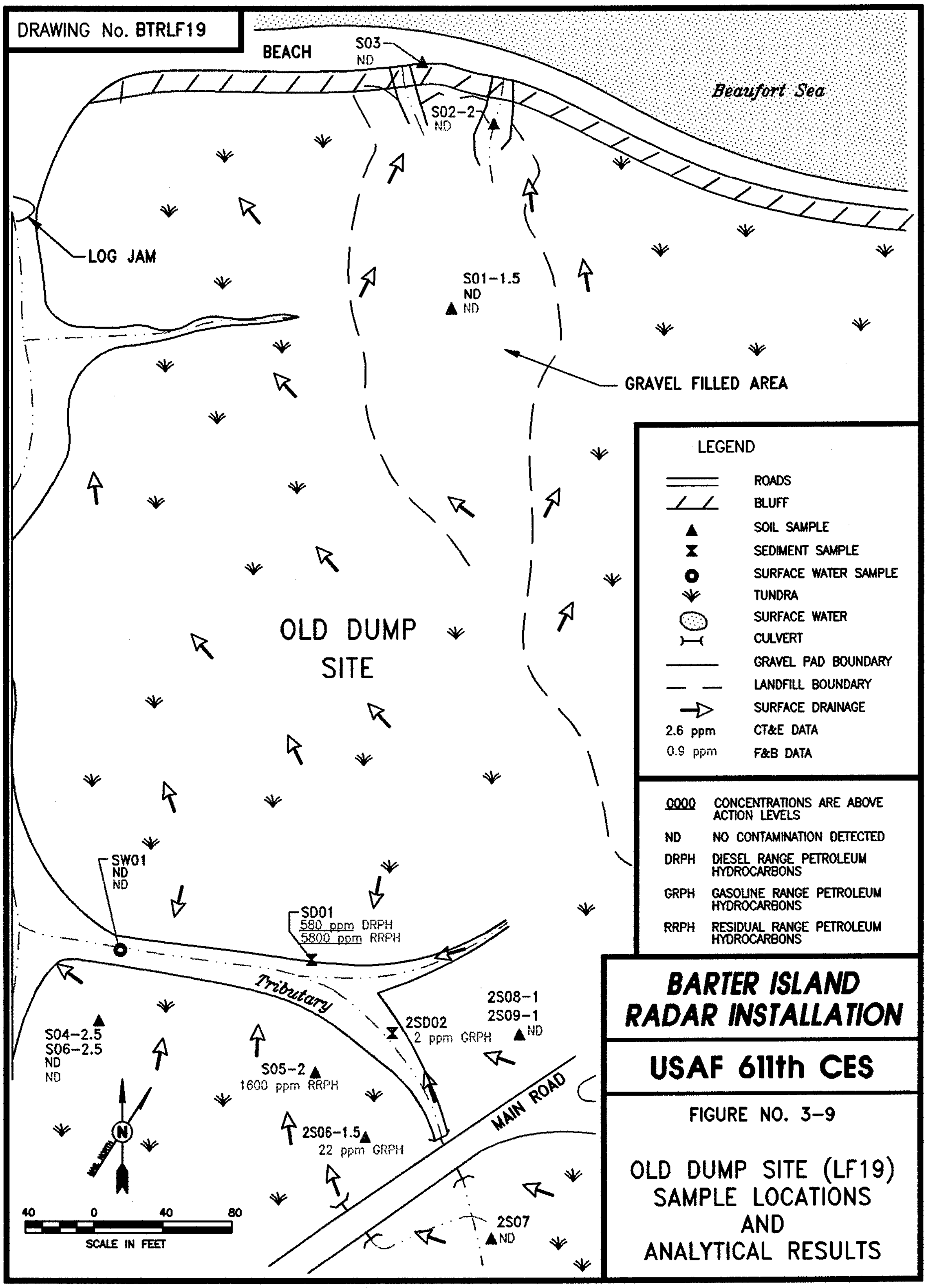
3.8.5.1 Chemicals of Concern. COCs were selected based on criteria presented in Section 3.1 of the ERA. The COCs detected in surface water were aluminum, iron, and manganese, and the COCs detected in soil/sediment were DRPH and zinc. No COCs were associated with elevated HQs at the Old Dump Site.

3.8.5.2 Summary of Ecological Risk Assessment. None of the COCs detected at the Old Dump Site were associated with potential ecological risk.

3.8.6 Conclusions and Recommendations

Sampling and analyses have determined that there is no significant contamination at the Old Dump Site (LF19). Petroleum hydrocarbons were detected in a few of the site samples; however, no source area or widespread areas of contamination were identified. No organic contaminants were detected in a surface water sample collected from a drainage pathway leading away from the site. The chemicals detected at the site are possibly associated with the past disposal practices at the site. The village of Kaktovik was located on this site from approximately 1952 to 1964.

The risk assessment concluded that risks posed to human health and ecological receptors by site contaminants are minimal given current or future site uses. Based on the RI sampling and analyses, risk assessment, and current site uses, remedial actions are not warranted at the site. Therefore, the Old Dump Site (LF19) site is recommended for no further action.



DRAWING No. BTRLF19
BEACH
Beaufort Sea
S03
ND
S02-2
ND
LOG JAM
S01-1.5
ND
ND
GRAVEL FILLED AREA
OLD DUMP SITE
SW01
ND
ND
SD01
580 ppm DRPH
5800 ppm RRPH
Tributary
2SD02
2 ppm GRPH
2S08-1
2S09-1
ND
S04-2.5
S06-2.5
ND
ND
S05-2
1600 ppm RRPH
2S06-1.5
22 ppm GRPH
MAIN ROAD
2S07
ND
N
40 0 40 80
SCALE IN FEET
LEGEND
ROADS
BLUFF
SOIL SAMPLE
SEDIMENT SAMPLE
SURFACE WATER SAMPLE
TUNDRA
SURFACE WATER
CULVERT
GRAVEL PAD BOUNDARY
LANDFILL BOUNDARY
SURFACE DRAINAGE
2.6 ppm CT&E DATA
0.9 ppm F&B DATA
0000 CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND NO CONTAMINATION DETECTED
DRPH DIESEL RANGE PETROLEUM HYDROCARBONS
GRPH GASOLINE RANGE PETROLEUM HYDROCARBONS
RRPH RESIDUAL RANGE PETROLEUM HYDROCARBONS
BARTER ISLAND RADAR INSTALLATION
USAF 611th CES
FIGURE NO. 3-9
OLD DUMP SITE (LF19) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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TABLE 3-15. OLD DUMP SITE ANALYTICAL DATA SUMMARY

Installation: Barter Island
Site: Old Dump Site (LF19)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks			Lab Blanks	
					S01-1.5	S02-2	S03	AB02	EB05	TB05		
Laboratory Sample ID Numbers					353 4301-9	355	357	315 4303-1	392/332 4303-5	375	#3&4-82493 #1&2-82493 4303	#6-82393 #1&2-82493 4301
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5.0-12	50-120	500[a]	9.55-1,150	<50J[b]	<50J[b]	<50J[b]	NA	<1,000[b]	NA	NA	<50J
GRPH	0.2-4.6	2-4.6	100	<0.400-<9.0	<46J[b]	<8J[b]	<5J[b]	<100J[b]	<100J[b]	<50J[b]	<100J	<2J
RRPH (Approx.)	10	100	2,000[a]	<480	<100	<100	<100	NA	<1,000	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	0.06R	<2.14	<1.54					
Benzene	0.002-0.005	0.02-0.05	0.5	<0.020-<0.300	<0.02R	<0.02	<0.02	<1	<1	<1	<1	<0.02J
Toluene	0.002-0.005	0.02-0.05		<0.020-<0.300	<0.02R	<0.02	<0.02	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002-0.005	0.02-0.05		<0.020-<0.300	0.06R	<0.8	<0.2	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004-0.010	0.04-0.1		<0.040-<0.600	<0.04R	<1.3	<1.3	<2	<2	<2	<1	<0.04
HVOC (8010 Mod.)	0.002-0.005	0.02-0.05		<0.5J	<0.02R	<0.02	<0.02	<1	<1	<1	<2	<0.02J
VOC 8260	0.020	0.020		<0.025-<0.050	<0.020	NA	NA	<1-6.3	<1-3.2	NA	<1	<0.020
SVOC 8270	0.200	0.200-1.00		<0.230-<3.50	<0.200-<1.00	NA	NA	NA	<11	NA	<10	<0.200
Pesticides	0.002-0.05	0.02-0.5		<0.001-<0.100	<0.02J-<0.5J	NA	NA	NA	<0.2-<10	NA	NA	<0.01-<0.5
PCBs	0.05-0.12	0.5-1.2	10	<0.020-<0.100	<0.5	<0.5	<0.5	NA	<10	NA	NA	<0.1-<0.5

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
R Result has been rejected.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE 3-15. OLD DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Old Dump Site (LF19)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples: S04-2.5 & S06-2.5 (Replicates)		Environmental Samples: S05-2	Field Blanks: AB02	Field Blanks: EB05	Field Blanks: TB05	Lab Blanks	
Laboratory Sample ID Numbers					359 4301-8	363 4301-10	361	315 4303-1	392/332 4303-5	375	#3&4-82493 #1&2-82493 4303	#8-82393 #1&2-82493 4301
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5.0-12	50-120	500[a]	9.55-1,150	<50J[b]	<50J[b]	<120J[b]	NA	<1,000[b]	NA	NA	<50J
GRPH	0.2-0.5	2-5	100	<0.4-<9	<3J[b]	<2J[b]	<5J[b]	<100J[b]	<100J[b]	<50J[b]	<100J	<2J
RRPH (Approx.)	10	100	2,000[a]	<480	<100	<100	1,800	NA	<1,000	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<1.24	<0.61	<0.80					
Benzene	0.002-0.005	0.02-0.05	0.5	<0.020-<0.300	<0.02	<0.02	<0.05	<1	<1	<1	<1	<0.02J
Toluene	0.002-0.005	0.02-0.05		<0.020-<0.300	<0.02	<0.02	<0.05	<1	<1	<1	<1	<0.02
Ethylbenzene	0.007-0.05	0.07-0.5		<0.020-<0.300	<0.5	<0.07	<0.2	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.05-0.07	0.5-0.7		<0.040-<0.600	<0.7	<0.5	<0.5	<2	<2	<2	<1	<0.04
HVOC (8010 Mod.)	0.002-0.005	0.02-0.05		<0.5J	<0.02	<0.02	<0.05	<1	<1	<1	<2	<0.020J
VOC 8260	0.020	0.020		<0.025-<0.050	<0.020	<0.020	NA	<1-6.3	<1-3.2	NA	<1	<0.020
SVOC 8270	0.200	0.20-0.710		<0.23-<3.5	<0.210-<0.710	<0.210-<1.00	NA	NA	<11	NA	<10	<0.200
Pesticides	0.002-0.05	0.02-0.5		<0.001-<0.100	<0.02J-<0.5J	NA	NA	NA	<0.2-<10	NA	NA	<0.01-<0.5
PCBs	0.05-0.12	0.5-1.2	10	<0.020-<0.100	<0.5	<0.5	<1.20	NA	<10	NA	NA	<0.1-<0.5
TOC				32,900-199,000	4,950	NA	NA	NA	5,000J	NA	<5,000	NA

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE 3-15. OLD DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Old Dump Site (LF19)

Matrix: Soil
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples						Field Blank			Lab Blanks
					S01-1.5	S04-2.5 & S06-2.5 (Replicates)						EB05		
Laboratory Sample ID Numbers					4301-9	4301-8	4301-10					4303-5		4303 4301
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L		µg/L
Aluminum	0.35	2		1,500-25,000	2,500	2,900	3,500					<100		<100
Antimony	N/A	49-52		<7.8-<230	<51	<52	<49					<100		<100
Arsenic	0.11	4.9-5.2		<4.9-8.5	<5.1	<5.2	<4.9					<100		<100
Barium	0.024	1		27-390	16	23	31					<50		<50
Beryllium	N/A	2.5-2.6		<2.6-6.4	<2.6	<2.6	<2.5					<50		<50
Cadmium	0.33	2.5-2.6		<3.0-<36	<2.6	<2.6	<2.5					<50		<50
Calcium	0.69	4		360-59,000	8,400	9,800J	12,000					<200		<200
Chromium	0.066	1		<4.3-47	5.0	5.4	7.4					<50		<50
Cobalt	N/A	4.9-5.2		<5.1-12	<5.1	<5.2	<4.9					<100		<100
Copper	0.045	1		<2.7-45	7.9	5.4	4.8					<50		<50
Iron	0.50	2		5,400-35,000	7,500	8,000	8,800					200		<100
Lead	0.13	4.9-5.2		<5.1-22	<51	<5.2J	<4.9					<100		<100
Magnesium	0.96	4		360-7,400	1,500	1,700J	1,900					<200		<200
Manganese	0.025	1		25-290	160	120	130					<50		<50
Molybdenum	N/A	2.5-2.6		<2.5-<11	<2.6	<2.6	<2.5					<50		<50
Nickel	0.11	1		4.2-46	6.9	6.8	7.8					<50		<50
Potassium	23	100		<300-2,200	340	390	410					<5,000		<5,000

☐ CT&E Data.
N/A Not available.
J Result is an estimate.

TABLE 3-15. OLD DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island | Matrix: Soil | METALS ANALYSES
Site: Old Dump Site (LF19) | Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples						Field Blank			Lab Blanks
					S01-1.5	S04-2.5 & S06-2.5 (Replicates)						EB05		
Laboratory Sample ID Numbers					4301-9	4301-8	4301-10					4303-5		4303 4301
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L		µg/L
Selenium	1.2	49-52		<7.8-<170	<51	<52	<49					<100		<100
Silver	0.53	2.5-2.6		<3-<110	<2.6	<2.6J	<2.5					<50		<50
Sodium	0.55	5		<160-680	53	60	70					<250		<250-267
Thallium	0.011	2.5-2.7		<0.2-<1.2	<0.25	<0.27	<0.26					<5		<5
Vanadium	0.036	1		6.3-59	5.8	6.6	9.3					<50		<50
Zinc	0.16	1		9.2-95	20	20	21					<50		<50

☐ CT&E Data.
J Result is an estimate.

TABLE 3-15. OLD DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island   Matrix: Soil
Site: Old Dump Site (LF19)   Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks		Lab Blanks	
					2S06-1.5	2S07	2S08-1 & 2S09-1 (Replicates)		AB02	EB06		
Laboratory Sample ID Numbers					1698	1700	1702	1704	315	1688	#5-9693 #3&4-82493 #1&2-9493	#3&4-9693
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	mg/kg
DRPH	5-10	50-100	500[a]	9.55-1,150	<100J[b]	<60J[b]	<50J[b]	<50J[b]	NA	<1,000J[b]	<1,000J	NA
GRPH	0.2	2	100	<0.400-<9.0	22J[b]	<2J[b]	<2J[b]	<2J[b]	<100J[b]	<50J[b]	<50J-<100J	<2
RRPH (Approx.)	10-20	100-200	2,000[a]	<480	<200	<120	<100	<100	NA	<1,000	<2,000	NA
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.20	<0.10	<0.10	<0.10				
Benzene	0.002-0.004	0.020-0.04	0.5	<0.020-<0.300	<0.04	<0.02	<0.02	<0.02	<1	<1	<1	<0.02
Toluene	0.002-0.004	0.020-0.04		<0.020-<0.300	<0.04	<0.02	<0.02	<0.02	<1	<4J	<1	<0.02
Ethylbenzene	0.002-0.004	0.020-0.04		<0.020-<0.300	<0.04	<0.02	<0.02	<0.02	<1	<2J	<1	<0.02
Xylenes (Total)	0.004-0.008	0.04-0.08		<0.040-<0.600	<0.08	<0.04	<0.04	<0.04	<2	<5J	<2	<0.04
HVOCs	0.01-0.02	0.1-0.2		<0.5J	<0.2	<0.1	<0.1	<0.1	<1	<1-<5J	<1	<0.1

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE 3-15. OLD DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island   Matrix: Sediment
Site: Old Dump Site (LF19)   Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples		Field Blanks			Lab Blanks	
					SD01	2SD02	AB02	EB05	TB05		
Laboratory Sample ID Numbers					351	1696	315 4303-1	392/332 4303-5	375	#3&4-82493 #1&2-82493	#6-82393 #5-9593 #3&4-9693 #1&2-82493
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	6	60	500[a]	9.55-1,150	580J[b]	<60J[b]	NA	<1,000[b]	NA	NA	<50J
GRPH	0.2-2.7	2-27	100	<0.400-<9.0	<27J[b]	2J[b]	<100J[b]	<100J[b]	<50J[b]	<50J-<100J	<2J
RRPH (Approx.)	12	120	2,000[a]	<480	5,800	<120	NA	<1,000	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	0.03R	<0.10					
Benzene	0.002	0.02	0.5	<0.020-<0.300	<0.02R	<0.02	<1	<1	<1	<1	<0.02J
Toluene	0.002	0.02		<0.020-<0.300	<0.02R	<0.02	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002	0.02		<0.020-<0.300	0.03R	<0.02	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004	0.04		<0.040-<0.600	<0.04R	<0.04	<2	<2	<2	<2	<0.04
HVOC (8010 Mod.)	0.002-0.001	0.02-0.1		<0.5J	<0.02R	<0.1	<1	<1	<1	<1	<0.1

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
R Result has been rejected.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE 3-15. OLD DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island   Matrix: Surface Water
Site: Old Dump Site (LF19)   Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Sample			Field Blanks			Lab Blanks
					SW01			AB02	EB05	TB05	
Laboratory Sample ID Numbers					307 4303-6			315 4303-1	392/332 4303-5	375	#3&4-82493 #1&2-82493 4303
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L			µg/L	µg/L	µg/L	µg/L
GRPH	10	100		<20	<100J[b]			<100J[b]	<100J[b]	<50J[b]	<50J-<100J
BTEX (8020/8020 Mod.)											
Benzene	0.1	1	5	<1	<1			<1	<1	<1	<1
Toluene	0.1	1	1,000	<1	<1			<1	<1	<1	<1
Ethylbenzene	0.1	1	700	<1	<1			<1	<1	<1	<1
Xylenes (Total)	0.2	2	10,000	<2	<2			<2	<2	<2	<2
HVOC 8010	0.1	1		NA	<1			<1	<1	<1	<1
VOC 8260	1	1		<1	<1-7.5U			5.1	<1	NA	<1
SVOC 8270	10	33		<10	<33			NA	<11	NA	<10
TOC	5,000	5,000		<5,000-12,700	34,600J			NA	<5,000J	NA	<5,000
TSS	100	200		<30,000-8,000	51,000J			NA	NA	NA	<200
TDS	10,000	10,000		<352,000-328,000	1,800,000J			NA	NA	NA	12,000

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
J Result is an estimate.
U Compound is not present above the concentration listed.
b GRPH concentrations reported for these samples are equivalent to gasoline range organics (GRO) as defined by ADEC.

TABLE 3-15. OLD DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Old Dump Site (LF19)
Matrix: Surface Water
Units: µg/L
METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample							Field Blank			Lab Blank
					SW01								EB05		
Laboratory Sample ID Numbers					4303-6								4303-5		4303
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L								µg/L		µg/L
Aluminum	17.4	100		<100-350 (<100-340)	160 (<100)								<100		<100 (<100)
Antimony	N/A	100	6	<100 (<100)	<100 (<100)								<100		<100 (<100)
Arsenic	5.3	100	50	<100 (<100)	<100 (<100)								<100		<100 (<100)
Barium	1.2	100	2,000	<50-93 (<50-91)	90 (140)								<50		<50 (<50)
Beryllium	N/A	50	4	<50 (<50)	<50 (<50)								<50		<50 (<50)
Cadmium	1.7	50	5	<50 (<50)	<50 (<50)								<50		<50 (<50)
Calcium	34.5	100		4,500-88,000 (4,100-86,000)	170,000 (160,000)								<200		<200 (<200)
Chromium	3.29	50	100	<50 (<50)	<50 (<50)								<50		<50 (<50)
Cobalt	N/A	100		<100 (<100)	<100 (<100)								<100		<100 (<100)
Copper	2.3	50	1,300	<50 (<50)	<50 (<50)								<50		<50 (<50)
Iron	25	100		180-2,800 (<100-1,600)	18,000 (1,800)								200		<100 (<100)
Lead	6.6	100	15	<100 (<100)	<100 (<100)								<100		<100 (<100)

☐ CT&E Data.
N/A Not available.

TABLE 3-15. OLD DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Old Dump Site (LF19)
Matrix: Surface Water
Units: µg/L
METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample							Field Blank			Lab Blank
					SW01								EB05		
Laboratory Sample ID Numbers					4303-6								4303-5		4303
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L								µg/L		µg/L
Magnesium	47.8	100		<5,000-53,000 (2,600-54,000)	72,000 (75,000)								<200		<200 (<200)
Manganese	1.24	50		<50-510 (<50-120)	70 (56)								<50		<50 (<50)
Molybdenum	N/A	50		<50 (<50)	<50 (<50)								<50		<50 (<50)
Nickel	5.5	50	100	<50 (<50)	<50 (<50)								<50		<50 (<50)
Potassium	1,154	100		<5,000 (<5,000)	7,600 (8,700)								<500		<5,000 (<5,000)
Selenium	62.4	100	50	<100 (<100)	<100 (<100)								<100		<100 (<100)
Silver	2.6	50	50	<50 (<50)	<50 (50)								<50		<50 (<50)
Sodium	27.7	100		8,400-410,000 (8,200-450,000)	250,000 (320,000)								<250		267 (267)
Thallium	0.57	5	2	<5 (<5)	<5 (<5)								<5		<5 (<5)
Vanadium	1.8	50		<50 (<50)	<50 (<50)								<50		<50 (<50)
Zinc	8.2	50		<50-160 (<50)	<50 (<50)								<50		<50 (<50)

☐ CT&E Data.
N/A Not available.

TABLE 3-16. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE OLD DUMP SITE (LF19)

SITE	MATRIX	CHEMICAL DETECTED[a]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[b] CANCER	RBSL[b] NON-CANCER	ARAR[c]	CHEMICAL OF CONCERN
Old Dump Site (LF19)	Soil	DRPH	580	mg/kg	9.55-1,150	--	--	500[d]	YES
		GRPH	22	mg/kg	<0.400-<9	--	--	100[d]	NO
		RRPH	5,800	mg/kg	<480	--	--	2,000[d]	YES
		Aluminum	3,500	mg/kg	1,500-25,000	--	--	--	NO
		Barium	31	mg/kg	27-390	--	1,890	--	NO
		Calcium	12,000	mg/kg	360-59,000	--	--	--	NO
		Chromium	7.4	mg/kg	<4.3-47	--	135	--	NO
		Copper	7.9	mg/kg	<2.7-45	--	999	--	NO
		Iron	8,800	mg/kg	5,400-35,000	--	--	--	NO
		Magnesium	1,900	mg/kg	360-7,400	--	--	--	NO
		Manganese	160	mg/kg	25-290	--	3,780	--	NO
		Nickel	7.8	mg/kg	4.2-46	--	540	--	NO
		Potassium	410	mg/kg	<300-2,200	--	--	--	NO
		Sodium	70	mg/kg	<160-680	--	--	--	NO
		Vanadium	9.3	mg/kg	6.3-59	--	189	--	NO
		Zinc	21	mg/kg	9.2-95	--	8,100	--	NO
	Water	Aluminum	160	µg/L	<100-350	--	--	--	NO
		Barium	140	µg/L	<50-93	--	256	2,000[e]	NO
		Calcium	170,000	µg/L	4,100-88,000	--	--	--	NO
		Iron	18,000	µg/L	<100-2,800	--	--	--	NO
		Magnesium	75,000	µg/L	<5,000-54,000	--	--	--	NO
		Manganese	70	µg/L	<50-510	--	18.3	--	NO
		Potassium	8,700	µg/L	<5,000	--	--	--	NO
		Sodium	320,000	µg/L	8,200-450,000	--	--	--	NO

a The concentrations reported for total metals in surface water are total metals.
b Risk-Based Screening Level.
c Applicable or Relevant and Appropriate Requirement.
d ADEC 1991.
e MCL, 56 FR 30266 (01 July 1991).

3.9 BLADDER DIESEL SPILL (SS20)

3.9.1 Site Background

The Bladder Diesel Spill (SS20) site is a water-saturated tundra area with a thin gravel cover located west of module train B. The Bladder Diesel Spill site was historically a storage area for arctic grade diesel fuels. Site personnel indicated the possibility of a previous fuel spill in this area. Although the bladder diesel tank has been removed, the area adjacent to the tank was suspected of containing petroleum hydrocarbons.

The site-specific environmental setting describing the topography, surface water drainage and soil types is presented in the discussion of potential migration pathways, Section 3.9.3.

3.9.2 Field Sampling and Analytical Results

This section describes the RI sampling and analytical results for samples collected at the Bladder Diesel Spill (SS20) site. The discussion presents a review of laboratory data, data summary tables, contaminants identified, contaminant trends, and information on suspected source areas.

3.9.2.1 Summary of Samples Collected. A total of seven samples was collected at the site. These consisted of three soil, two sediment, and two surface water samples. Table 2-2 presents a detailed summary of the samples collected and the analyses performed during the 1993 RI field activities. Locations of all samples collected at the Bladder Diesel Spill (SS20) site and a summary of analytical results above background levels are presented in Figure 3-10.

Three soil samples were analyzed for DRPH, GRPH, and RRPH. In addition, two samples were analyzed for BTEX, VOCs, SVOCs, total metals, and TOC.

Two sediment samples were analyzed for DRPH and RRPH. In addition, one sample was analyzed for GRPH, BTEX, VOCs, SVOCs, total metals, and TOC.

Two surface water samples were analyzed for DRPH, GRPH, RRPH, and BTEX. In addition, one sample was analyzed for VOCs, TOC, TSS, and TDS.

3.9.2.2 Analytical Results. The data summary table (Table 3-17) presents analytical results for all samples collected at the site. Detection and quantitation limits, action levels, associated laboratory and field blanks, and background analytical results are presented for each of the analyses. Background levels are listed to allow direct comparison of naturally occurring organic compounds and inorganic analytes with samples collected from the site. Sample locations and analytical results for the samples at the site are illustrated in Figure 3-10. All organic compounds detected are presented on the figure except when they were a result of laboratory contamination or field decontamination procedures. The exceptions are presented on the data summary table. Only metals detected above background levels are presented on Figure 3-10.

The following section presents a discussion of organic compounds and inorganic analytes detected above background levels at the site. A discussion of TDS, TSS, and TOC is included.

Organics. Organic compounds detected in soil/sediment samples collected at the site include VOCs and SVOCs. Two VOCs and three SVOCs were detected at low levels in sediment sample SS20-SD01, ranging between 0.097 to 1.96 mg/kg.

In surface water samples, only one organic compound was detected at low levels. One VOC (naphthalene) was detected in sample SS20-SW01 at 2.7 μg/L.

Inorganics. Metals analyses detected one metal (magnesium) above background concentrations in replicate soil sample SS20-S03-1/S04-1.

TOC ranged from 1,150 to 3,750 mg/kg in the three soil/sediment samples (SS20-S02-0.75, SS20-S03-1/S04-1 and SS20-SD01). TOC, TSS, and TDS were reported at 31,400; 84,000; and 903,000 μg/L, respectively in surface water sample SS20-SW01.

3.9.2.3 Summary of Site Contamination. There does not appear to be any significant contamination at the site. No previous sampling has been conducted at the site. Very low levels or organic compounds were identified in only two of nine samples. The human health and ecological risks associated with chemicals detected at the site are presented in Sections 3.9.4 and 3.9.5.

3.9.3 Migration Pathways

This section describes the topography and stratigraphy of the site and the migration potential of contaminants from the site. A discussion of receptors and chemical concentrations at receptors is included.

3.9.3.1 Topography and Stratigraphy. The topography of the site consists of relatively flat tundra with a thin gravel cover in some portions of the site. The areas is wet and marshy. It is bounded to the west and south by tundra and to the north and east by a gravel pad. The surrounding landscape drains radially into the site (Figure 3-10).

During the 1993 RI, permafrost was located at a depth of approximately two and a half feet at the site. The gravel cover consisted of typical gravels and sands associated with these features, and subsurface tundra materials were typical of the stratigraphy found at Barter Island (Section 2.4.4.2).

3.9.3.2 Migration Potential. There does not appear to be a potential migration pathway from the site. In addition, because there is no significant contamination at the site, migration potential is not a concern.

3.9.3.3 Receptors and Chemical Concentrations at Receptors.

Human Receptors. Potential human receptors at the Bladder Diesel Spill site include Air Force contractor personnel working at the station, visitors to the station, and an occasional local visitor passing the site to get to recreational or subsistence lands. Human receptors could potentially be exposed to the chemicals detected in surface water and soils/sediments at the site. The primary routes of potential exposures at the site are direct contact with soils/sediments, incidental ingestion of soils/sediments, and ingestion of surface water. Because groundwater and air at the Barter Island sites are not considered complete pathways of exposure, these media are not evaluated as potential pathways to human receptors.

The Barter Island Risk Assessment (U.S. Air Force 1996) evaluates in detail the risks to human health from all COCs detected at the site. The potential receptor groups were selected based on their likelihood of exposure to contaminants at the site, and include DEW Line workers at the installation, and native adults and children who may visit the site. The estimated exposure point concentrations for human receptors are based on the maximum concentration of each chemical detected at the site. The potential risks to human health associated with site chemicals at Barter Island are presented in Section 3.9.4.

Ecological Receptors. Ecological receptors were evaluated in detail in the Barter Island Risk Assessment (U.S. Air Force 1996) to determine if plants and animals could potentially be impacted by the chemicals detected at the Barter Island installation. Because of the diversity of the plants and animals in the area of the Barter Island installation, a set of representative species was selected in the ERA for detailed evaluation. The species include plants, aquatic invertebrates, fish, birds, and mammals. These receptors were selected based on the species' likelihood of exposure given their preferred habitat and feeding habits. The representative species encompass a range of ecological niches in order to achieve the best characterization of the ecosystems being examined and are presented in Table 2-6.

The estimate of chemical concentrations at the ecological receptors was based on the average site-wide concentration of each COC. This approach was appropriate because few of the representative species would inhabit only one distinct site at the installation; they are more likely to be exposed to the mix of chemicals and concentrations detected on all the sites at Barter Island. The potential ecological risks associated with the chemicals detected at the site are presented in Section 3.9.5.

3.9.4 Human Health Risk Assessment

This section presents a summary of the potential human health risks associated with the chemicals detected at the Bladder Diesel Spill (SS20) site. The purpose of the human health risk assessment is to quantify the excess lifetime cancer risk and/or the noncancer hazard (reported as hazard index) for the contaminants detected at the site.

This summary presents the COCs at the site, the pathways by which human receptors may be exposed to site chemicals, potential risks to human health posed by each chemical through each exposure pathway, the significance of the risk and/or hazard estimate, and a comparison of site

chemical concentrations to ARARs. The methods and assumptions used in calculating site hazards and risks is presented in Section 2.4.1.

3.9.4.1 Chemicals of Concern. At the Bladder Diesel Spill (SS20), no COCs were identified for the soil/sediment or surface water matrices at the site. No organic constituents were detected in samples from the site, and no metal concentrations were above background levels, RBSL, or ARARs. Therefore, there are no apparent potential risks or hazards to human health from chemicals detected at the site.

Table 3-18, Identification of COCs at the Bladder Diesel Spill, presents the maximum concentrations of chemicals detected at the site and the associated background concentrations, RBSLs, and ARARs, and identifies that no COCs were selected in the risk evaluation.

3.9.4.2 Summary of Human Health Risk Assessment. There were no COCs identified in the soil/sediment or surface water matrices at the Bladder Diesel Spill site. Therefore, there were no COCs to evaluate. Based on the human health risk assessment, remedial actions are not warranted at the site.

3.9.5 Ecological Risk Assessment

The objective of the ERA is to estimate the potential impacts of chemicals detected at the installation to aquatic and terrestrial plants and animals. A summary of the methods used to assess potential ecological impacts is presented in Section 2.4.2.

3.9.5.1 Chemicals of Concern. COCs were selected based on criteria presented in Section 3.1 of the ERA. No COCs were detected in surface water, and the COCs detected in soil/sediment were naphthalene, lead, and zinc. No COCs were associated with elevated HQs at the Bladder Diesel Spill site.

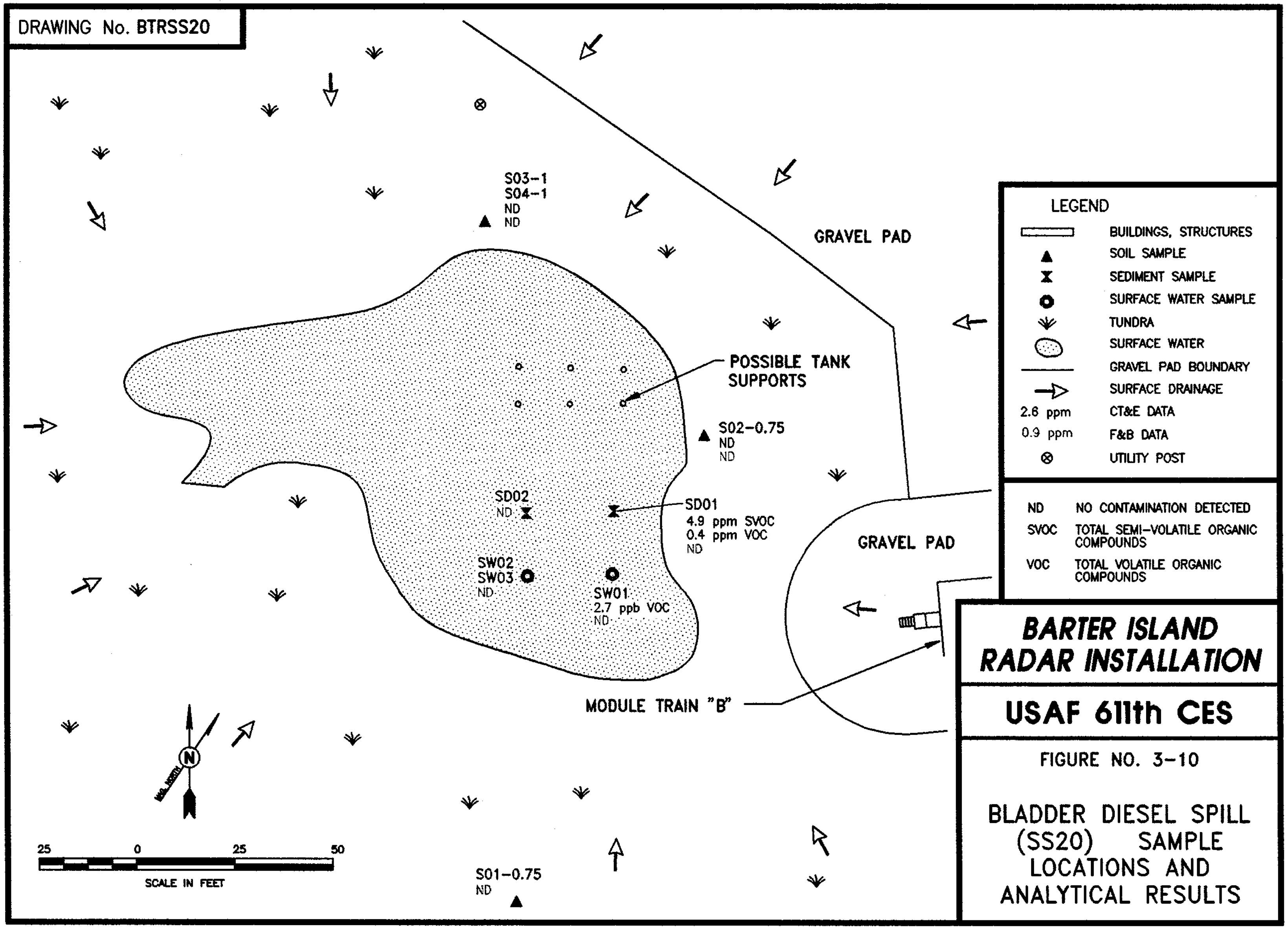
3.9.5.2 Summary of Ecological Risk Assessment. None of the COCs detected at the Bladder Diesel Spill site were associated with potential ecological of risk.

3.9.6 Conclusions and Recommendations

Sampling and analyses have determined that there is no significant contamination at the Bladder Diesel Spill (SS20) site. Very low levels of contaminants were detected in only two of the nine samples collected, and no COCs were identified at the site. The site was investigated because it was a former bladder storage tank and reported diesel spill. The reported spills at the site were either minor in nature or have bioremediated to the near non-detect levels currently at the site.

The risk assessment concluded that no COCs were present at the site; therefore, there is no apparent risk to human or ecological receptors.

Based on the RI sampling and analysis, risk assessment, and current site uses, remedial actions are not warranted at the site. Therefore, the Bladder Diesel Spill (SS20) site is recommended for no further action.



BARTER ISLAND RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 3-10

BLADDER DIESEL SPILL (SS20) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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TABLE 3-17. BLADDER DIESEL SPILL ANALYTICAL DATA SUMMARY

Installation: Barter Island Matrix: Soil
Site: Bladder Diesel Spill (SS20) Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blanks	
					S01-0.75	S02-0.75	S03-1 & S04-1 (Replicates)		AB02	EB05	TB05		
Laboratory Sample ID Numbers					402	400 4305-6	385 4305-5	380 4305-4	315 4303-1	392/332 4303-5	375	#3&4-82493 #1&2-82493 4303	#6-82393 #1&2-82493 4305
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5	50	500[a]	9.55-1,150	<50J[b]	<50J[b]	<50J[b]	<50J[b]	NA	<1,000[b]	NA	NA	<50J
GRPH	0.2-20	2-200	100	<0.400-<9.0	<2J[b]	<2J[b]	<50J[b]	<200J[b]	<100J[b]	<100J[b]	<50J[b]	<50J-<100J	<2J
RRPH (Approx.)	10	100	2,000[a]	<480	<100	<100	<100	<100	NA	<1,000	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.10J	<0.10J	<0.10R	<0.10R					
Benzene	0.002	0.02	0.5	<0.020-<0.300	<0.02J	<0.02J	<0.02R	<0.02R	<1	<1	<1	<1	<0.02J
Toluene	0.002	0.02		<0.020-<0.300	<0.02	<0.02	<0.02R	<0.02R	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002	0.02		<0.020-<0.300	<0.02	<0.02	<0.02R	<0.02R	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004	0.04		<0.040-<0.600	<0.04	<0.04	<0.04R	<0.04R	<2	<2	<2	<2	<0.04
VOC 8260	0.020	0.020		<0.025-<0.500	NA	<0.020	<0.020	<0.020	<1-6.3	<1-3.2	NA	<1	<0.020
SVOC 8270	0.200	0.210-1.00		<0.230-<3.50	NA	<0.210-<1.00	<0.220-<1.00	<0.220-<1.00	NA	<11	NA	<10	<0.200
TOC				32,000-199,000	NA	1,150	3,750	2,970	NA	<5,000J	NA	<5,000	NA

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
R Result has been rejected.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE 3-17. BLADDER DIESEL SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Bladder Diesel Spill (SS20)

Matrix: Soil/Sediment
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples							Field Blank			Lab Blanks
					S02-0.75	S03-1 & S04-1 (Replicates)		SD01					EB05		
Laboratory Sample ID Numbers					4305-6	4305-5	4305-4	4305-1					4303-5		4305 4303
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L		µg/L
Aluminum	0.35	2		1,500-25,000	1,600	2,100	2,000	2,000					<100		<100
Antimony	N/A	2-58		<7.8-<230	<52	<53	<53	<58					<100		<100
Arsenic	0.11	5.2-5.8		<4.9-8.5	<5.2	<5.3	<5.3	<5.8					<100		<100
Barium	0.024	1		27-390	13	18	18	20					<50		<50
Beryllium	N/A	2.6-2.9		<2.6-6.4	<2.6	<2.7	<2.7	<2.9					<50		<50
Cadmium	0.33	2.6-2.9		<3.0-<36	<2.6	<2.7	<2.7	<2.9					<50		<50
Calcium	0.69	4		360-59,000	13,000	3,700	33,000	5,600					<200		<200
Chromium	0.066	1		<4.3-47	3.0	4.7	4.0	9.3					<50		<50
Cobalt	N/A	5.2-5.8		<5.1-12	<5.2	<5.3	<5.3	<5.8					<100		<100
Copper	0.045	1		<2.7-45	4.8	4.7	4.9	6.6					<50		<50
Iron	0.50	2		5,400-35,000	6,000	5,800	6,200	5,700					200		<100
Lead	0.13	2-5.2		<5.1-22	<5.2	11	8.5	9.2					<100		<100
Magnesium	0.96	4		360-7,400	5,600J	1,800	17,000	2,900J					<200		<200
Manganese	0.025	1		25-290	69	69	77	69					<50		<50
Molybdenum	N/A	2.6-2.9		<2.5-<11	<2.6	<2.7	<2.7	<2.9					<50		<50
Nickel	0.11	1		4.2-46	5.6	5.3	4.6	7.7					<50		<50
Potassium	23	260-290		<300-2,200	<260	<270	<270	<290					<5,000		<5,000

☐ CT&E Data.
N/A Not available
J Result is an estimate.

TABLE 3-17. BLADDER DIESEL SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Bladder Diesel Spill (SS20)
Matrix: Soil/Sediment
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples							Field Blank			Lab Blanks
					S02-0.75	S03-1 & S04-1 (Replicates)		SD01					EB05		
Laboratory Sample ID Numbers					4305-6	4305-5	4305-4	4305-1					4303-5		4305 4303
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L		µg/L
Selenium	1.2	5.2-5.8		<7.8-<170	<5.2	<5.3	<5.3	<5.8					<100		<100
Silver	0.53	2.6-2.9		<3-<110	<2.6	<2.7	<2.7	<2.9					<50		<50
Sodium	0.55	5		<160-680	52	61	58	80					<250		<250-267
Thallium	0.011	0.25-0.3		<0.2-<1.2	<0.25	<0.27	<0.28	<0.30					<5		<5
Vanadium	0.036	1		6.3-59	4.9	6.0	6.3	6.7					<50		<50
Zinc	0.16	1		9.2-95	13	2.7	21	30					<50		<50

☐ CT&E Data.

TABLE 3-17. BLADDER DIESEL SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Bladder Diesel Spill (SS20)
Matrix: Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples		Field Blanks			Lab Blanks	
					SD01	SD02	AB02	EB05	TB05		
Laboratory Sample ID Numbers					378 4305-1	381/382	315 4303-1	392/332 4303-5	375	#3&4-82493 #1&2-82493 4303	#6-82393 #1&2-82493 4305
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5	50	500[a]	9.55-1,150	<50J[b]	<50J[b]	NA	<1,000[b]	NA	NA	<50J
GRPH	0.2-9	2-90	100	<0.400-<9.0	<90J[b]	<2R[b]	<100J[b]	<100J[b]	<50J[b]	<50J-<100J	<2J
RRPH (Approx.)	10	100	2,000[a]	<480	<100	<100	NA	<1,000	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.13	<0.10R					
Benzene	0.002	0.02	0.5	<0.020-<0.300	<0.02	<0.02R	<1	<1	<1	<1	<0.02J
Toluene	0.002	0.02		<0.020-<0.300	<0.02	<0.02R	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002-0.003	0.02-0.03		<0.020-<0.300	<0.03	<0.02R	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004-0.006	0.04-0.06		<0.040-<0.600	<0.06	<0.04R	<2	<2	<2	<2	<0.04
VOC 8260											
Naphthalene	0.020	0.020		<0.025-<0.500	0.280	NA	<1	<1	NA	<1	<0.020
Toluene	0.020	0.020		<0.025-<0.500	0.097	NA	2.2	2.3	NA	<1	<0.020

☐ CT&E Data.
▦ F&B Data.
NA Not analyzed.
J Result is an estimate.
R Result has been rejected.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have yet to be determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE 3-17. BLADDER DIESEL SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Bladder Diesel Spill (SS20)

Matrix: Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples		Field Blanks			Lab Blanks	
					SD01	SD02	AB02	EB05	TB05		
Laboratory Sample ID Numbers					378 4305-1	381/382	315 4303-1	392/332 4303-5	375	#3&4-82493 #1&2-82493 4303	#6-82393 #1&2-82493 4305
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
SVOC 8270											
Fluoranthene	0.200	2.40		<0.230-<3.50	1.70J	NA	NA	<11	NA	<10	<0.200
Phenanthrene	0.200	2.40		<0.230-<3.50	1.96J	NA	NA	<11	NA	<10	<0.200
Pyrene	0.200	2.40		<0.230-<3.50	1.26J	NA	NA	<11	NA	<10	<0.200
TOC				32,000-199,000	3,360	NA	NA	<5,000J	NA	<5,000	NA

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.

TABLE 3-17. BLADDER DIESEL SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Surface Water
Site: Bladder Diesel Spill (SS20) Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blanks
					SW01	SW02 & SW03 (Duplicates)			AB02	EB05	TB05	
Laboratory Sample ID Numbers					398/388 4305-7	403/406	407/410		315 4303-1	392/332 4303-5	375	#3&4-82493 #1&2-82493 4305 4303
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L		µg/L	µg/L	µg/L	µg/L
DRPH	100	1,000		<200	<1,000J[b]	<1,000J[b]	<1,000J[b]		NA	<1,000[b]	NA	NA
GRPH	10	100		<20	<100J[b]	<100J[b]	<100J[b]		<100J[b]	<100J[b]	<50J[b]	<50J-<100J
RRPH (Approx.)	200	2,000		NA	<2,000	<2,000	<2,000		NA	<1,000	NA	NA
BTEX (8020/8020 Mod.)												
Benzene	0.1	1	5	<1	<1	<1	<1		<1	<1	<1	<1
Toluene	0.1	1	1,000	<1	<1	<1	<1		<1	<1	<1	<1
Ethylbenzene	0.1	1	700	<1	<1	<1	<1		<1	<1	<1	<1
Xylenes (Total)	0.2	2	10,000	<2	<2	<2	<2		<2	<2	<2	<2
VOC 8260												
1,2-Dichloroethane	1	1	5	3U-3.2B	2.8B	NA	NA		6.3	3.2	NA	<1
Naphthalene	1	1		<1	2.7	NA	NA		<1	<1	NA	<1

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
J Result is an estimate.
U Compound is not present above the concentration listed.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE 3-17. BLADDER DIESEL SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Bladder Diesel Spill (SS20)
Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blanks
					SW01	SW02 & SW03 (Duplicates)			AB02	EB05	TB05	
Laboratory Sample ID Numbers					398/388 4305-7	403/406	407/410		315 4303-1	392/332 4303-5	375	4305 4303
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L		µg/L	µg/L	µg/L	µg/L
SVOCs	10	10		<10	<10	NA	NA		NA	<11	NA	<10
TOC	5,000	5,000		<5,000-12,700	31,400	NA	NA		NA	<5,000J	NA	<5,000
TSS	100	200		<30,000-8,000	84,000J	NA	NA		NA	NA	NA	<200
TDS	10,000	10,000		<352,000-328,000	903,000J	NA	NA		NA	NA	NA	<10,000

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.

TABLE 3-18. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE BLADDER DIESEL SPILL (SS20)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a]		ARAR[b]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Bladder Diesel Spill (SS20)	Soil	Naphthalene	0.280	mg/kg	<0.025-<3.50	--	100	--	NO
		Toluene	0.097	mg/kg	<0.020-<0.500	--	5,400	--	NO
		Phenanthrene	1.96	mg/kg	<0.230-<3.50	--	--	--	NO
		Fluoranthene	1.70	mg/kg	<0.230-<3.50	--	1,080	--	NO
		Pyrene	1.26	mg/kg	<0.230-<3.50	--	810	--	NO
		Aluminum	2,100	mg/kg	1,500-25,000	--	--	--	NO
		Barium	20	mg/kg	27-390	--	1,890	--	NO
		Calcium	33,000	mg/kg	360-59,000	--	--	--	NO
		Chromium	9.3	mg/kg	<4.3-47	--	135	--	NO
		Copper	6.6	mg/kg	<2.7-45	--	999	--	NO
		Iron	6,200	mg/kg	5,400-35,000	--	--	--	NO
		Lead	11	mg/kg	<5.1-22	--	--	500[c]	NO
		Magnesium	17,000	mg/kg	360-7,400	--	--	--	NO
		Manganese	77	mg/kg	25-290	--	3,780	--	NO
		Nickel	7.7	mg/kg	4.2-46	--	540	--	NO
		Sodium	80	mg/kg	<160-680	--	--	--	NO
		Vanadium	6.7	mg/kg	6.3-59	--	189	--	NO
		Zinc	30	mg/kg	9.2-95	--	8,100	--	NO
	Water	Naphthalene	2.7	µg/L	<1-<10	--	--	--	NO

a Risk-Based Screening Level.
b Applicable or Relevant and Appropriate Requirement.
c EPA 1989d.

4.0 REMEDIAL INVESTIGATION - SITE REQUIRING FURTHER CHARACTERIZATION

This section of the RI/FS presents results from RI sampling and analysis activities for the one Barter Island site, the JP-4 Spill (SS21), where further characterization may be warranted. The information presented in this section includes site background, field sampling and analytical results, potential migration pathways, human health and ecological risk assessment summaries, and conclusions and recommendations. (Note: figures and tables are presented at the end of each section.) The discussions in this section are intended to provide the reader with all site information needed to understand the site conditions and make decisions regarding appropriate action for the site.

Photographs of the Barter Island installation and the sites investigated during the RI are presented in Appendix B. Data tables presented in this section list analytical results from samples in which chemicals were detected above quantitation limits. Complete laboratory analytical data sheets for each sample, including quantitation limits for non-detected analytes, are presented in Appendix F.

4.1 JP-4 SPILL (SS21)

4.1.1 Site Background

The JP-4 Spill site (SS21) is located approximately 1,300 feet east of the main facility. This reported fuel spill was from a cut in an approximately six-inch diameter JP-4 fuel line approximately 100 yards below the JP-4 fuel tank. The fuel line runs from the JP-4 fuel tank to the hangar area. Site personnel indicated that a village diesel spill occurred upgradient of the JP-4 Spill area, and some of the product from the village spill may have migrated onto the site.

The site-specific environmental setting describing the topography, surface water drainage, and soil types is presented in the discussion of potential migration pathways, Section 4.1.3.

4.1.2 Field Sampling and Analytical Results

This section describes the RI sampling and analytical results for samples collected at the JP-4 Spill site. The discussion presents a review of laboratory data, data summary tables, contaminants identified, contaminant trends, and information on suspected source areas.

4.1.2.1 Summary of Samples Collected. A total of five soil samples was collected at the site. Table 2-2 presents a detailed summary of the samples collected and the analyses performed during the 1993 RI field activities. Locations of all samples collected at the JP-4 Spill (SS21) site and a summary of analytical results above background levels are presented in Figure 4-1.

Five soil samples were analyzed for DRPH and RRPH. In addition, four samples were analyzed for GRPH, BTEX, and HVOCs. One sample was analyzed for VOCs, SVOCs, pesticides, and TOC.

4.1.2.2 Analytical Results. The data summary table (Table 4-1) presents analytical results for all samples collected at the site. Detection and quantitation limits, action levels, associated laboratory and field blanks, and background analytical results are presented for each of the analyses. Background levels are listed to allow direct comparison of naturally occurring organic compounds with samples collected from the site. Sample locations and analytical results for the JP-4 Spill site are illustrated in Figure 4-1. All organic compounds detected are presented on the figure except when they were a result of laboratory contamination or field decontamination procedures. The exceptions are presented on the data summary table.

The following section presents a discussion of organic compounds detected at the site. A discussion of the TOC result is included.

Organics. Organic compounds detected in soil and sediment samples collected at the site include DRPH, GRPH, BTEX, nine other VOCs, and SVOCs. DRPH were detected in two soil samples at 1,000 and 1,300 mg/kg (samples SS21-S02 and SS21-S03, respectively). GRPH were detected in the same respective samples at 300 and 280 mg/kg. BTEX (total) were detected in two soil samples, SS21-S02 and SS21-S03, at 104.8 and 38 mg/kg, respectively. Xylenes were the primary component; however, benzene was detected in one sample at 3.9 mg/kg. Nine other VOCs, all components of gasoline, were detected in sample SS21-S02 ranging from 0.345 to 18.1 mg/kg. Two SVOCs (naphthalene and 2-methylnaphthalene) were detected at low levels in soil sample SS21-S02 (0.274 and 1.42 mg/kg, respectively).

Inorganics. Metals were not a concern at the site, and no metals analyses were performed. TOC was reported at 2,200 mg/kg in soil sample SS21-S02.

4.1.2.3 Summary of Site Contamination. Petroleum compounds were detected in two soil samples at the JP-4 Spill (SS21) site. The source of the contaminants is suspected to be fuel spills that occurred in the area. No previous sampling had been conducted at the site. The contaminated area at the site includes gravel pad and tundra; however, additional samples should be collected at the site in order to more fully characterize contaminant extent.

4.1.3 Migration Pathways

This section describes the topography and stratigraphy of the site and the migration potential of contaminants from the site. A discussion of receptors and chemical concentrations at receptors is included.

4.1.3.1 Topography and Stratigraphy. The topography of this area consists of gravel roads and berms placed upon relatively flat tundra (Figure 4-1). Near the northern portion of the site a drainage ditch passes through a culvert under a gravel pad and Building 2002 and continues eastward, but there are no other distinct drainage features.

During the 1993 RI, permafrost was located at a depth of approximately 2-1/2 feet in tundra areas and 4 feet under gravel berms and roads. Gravel berms and roads consisted of the typical gravels and sands associated with these features, and subsurface tundra materials were of the typical stratigraphy found at Barter Island (Section 2.4.4.2).

4.1.3.2 Migration Potential.

Subsurface Migration. Topography indicates that any subsurface flow that does occur is towards the east. Because the topography is generally flat, there is only a slight gradient to drive the flow of active layer water. Analytical data suggest that the site is generally clean south of where the JP-4 pipeline crosses under the road. Data indicate that a release of petroleum hydrocarbons has occurred where this pipeline makes a right angle bend (immediately prior to where it crosses under the road and gravel pad). Because this location is adjacent to a drainage ditch, any subsurface flow may be directed into this ditch.

Surface Migration. The only distinct drainage feature in the vicinity of the suspected spill is a small drainage ditch. This ditch crosses under the road and Building 2002 through a culvert and continues east to a marshy tundra area. Analytical evidence indicates that a petroleum release occurred near the culvert on the western side of the road leading to the village fuel tanks. A soil sample taken near the culvert outfall on the east side of the road indicated the presence of petroleum hydrocarbons, suggesting some migration has occurred. Significant migration is probably restricted to the spring thaw, when large quantities of meltwater are available to flow through the ditch and culvert.

Air Transport. Air transportation is not considered to be a significant mode of migration at the site (Section 2.4.4.5).

Summary of Migration Potential. Analytical data suggest that some surface migration of petroleum hydrocarbons has occurred through the culvert into gravel and tundra areas to the east of Building 2002. If transport still occurs, it is probably most significant in the spring.

4.1.3.3 Receptors and Chemical Concentrations at Receptors.

Human Receptors. Potential human receptors at the JP-4 Spill site include Air Force contractor personnel working at the station, visitors to the station, and local inhabitants of Kaktovik. Human receptors could potentially be exposed to the chemicals detected in soils/sediments at the site. The primary routes of potential exposures at the site are direct contact with soils/sediments and incidental ingestion of soils/sediments. Surface water was not considered a route of exposure at the site because there was not a sufficient depth of water to allow collection of water samples from the site. Because groundwater and air at the Barter Island sites are not considered complete pathways of exposure, these media are not evaluated as potential pathways to human receptors.

The Barter Island Risk Assessment (U.S. Air Force 1996) evaluates in detail the risks to human health from all COCs detected at the site. The potential receptor groups were selected based on their likelihood of exposure to contaminants at the site and include DEW Line workers at the

installation, and native adults and children who may visit the site. The estimated exposure point concentrations for human receptors is based on the maximum concentration of each chemical detected at the site. The potential risks to human health associated with site chemicals at Barter Island are presented in Section 4.1.4.

Ecological Receptors. Ecological receptors were evaluated in detail in the Barter Island Risk Assessment (U.S. Air Force 1996) to determine if plants and animals could potentially be impacted by the chemicals detected at the Barter Island installation. Because of the diversity of the plants and animals in the area of the Barter Island installation, a set of representative species were selected in the ERA for detailed evaluation. The species include plants, aquatic invertebrates, fish, birds, and mammals. These receptors were selected based on the species' likelihood of exposure given their preferred habitat and feeding habits. The representative species encompass a range of ecological niches in order to achieve the best characterization of the ecosystems being examined and are presented in Table 2-6.

The estimate of chemical concentrations at the ecological receptors was based on the average site-wide concentration of each COC. This approach was appropriate because few of the representative species would inhabit only one distinct site at the installation; they are more likely to be exposed to the mix of chemicals and concentrations detected on all the sites at Barter Island. The potential ecological risks associated with the chemicals detected at the site are presented in Section 4.1.5.

4.1.4 Human Health Risk Assessment

This section presents a summary of the potential human health risks associated with the chemicals detected at the JP-4 Spill (SS21) site. The purpose of the human health risk assessment is to quantify the excess lifetime cancer risk and/or the noncancer hazard (reported as hazard index) for the contaminants detected at the site.

This summary presents the COCs at the site, the pathways by which human receptors may be exposed to site chemicals, potential risks to human health posed by each chemical through each exposure pathway, the significance of the risk and/or hazard estimate, and a comparison of site chemical concentrations to ARARs. The methods and assumptions used in calculating hazards and risks is presented in Section 2.4.1.

4.1.4.1 Chemicals of Concern. At the JP-4 Spill (SS21), COCs identified in the soil/sediment at the site included DRPH, GRPH, and benzene. DRPH and GRPH were selected as COCs because the maximum concentrations detected exceeded ARARs. Benzene was selected as a COC because the maximum concentration detected exceeded the RBSL. Surface water samples were not collected at this site.

Table 4-2, Identification of COCs at the JP-4 Spill, presents the maximum concentrations of chemicals detected at the site and the associated background concentrations, RBSLs, and ARARs, and identifies COCs selected in the risk evaluation.

4.1.4.2 Exposure Pathways and Potential Receptors. Ingestion of soil/sediment was determined to be a potential exposure pathway at the site. Because no surface water samples were collected at the site, no evaluation of risk or hazard was conducted for water ingestion.

Three potential receptor groups were evaluated in the risk assessment: an adult assigned to a DEW Line installation (worker), an adult inhabitant of communities in the North Slope of Alaska (native), and a child living in a North Slope community (child).

4.1.4.3 Risk Characterization.

Noncancer Hazard and Cancer Risk Associated with Soils and Sediments. The noncancer hazard associated with the ingestion of soil at the JP-4 Spill (SS21) site by a hypothetical native northern adult/child is 0.022, and by a DEW Line worker is 0.001, based on the maximum concentrations of the COCs. The presence of DRPH and GRPH accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations. The excess lifetime cancer risk associated with the ingestion of soil at the site by a hypothetical native northern adult/child is 1×10^{-7}, and by a DEW Line worker is 5×10^{-9}, based on the maximum concentrations of the COCs. The presence of GRPH and benzene accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

Noncancer Hazard and Cancer Risk Associated with Surface Water. No surface water bodies were identified at the JP-4 Spill (SS21). Therefore, there is no apparent surface water pathway, and no evaluation of noncancer hazard or excess lifetime cancer risk associated with ingestion of surface water at the site was conducted.

4.1.4.4 Summary of Human Health Risk Assessment. The potential risks and hazards associated with the soil/sediment at the JP-4 Spill are the very low noncancer hazards (hazard indices of 0.001 and 0.022) and very low cancer risks ($<10^{-7}$) associated with the DRPH, GRPH, and benzene detected at the site. The noncancer hazards and carcinogenic risks are significantly below regulatory threshold values (EPA 1991c). In addition these hazards and risks were calculated conservatively based on maximum concentrations detected and using a residential scenario. Therefore, the noncancer hazards and carcinogenic risks associated with soil/sediment at the site are minimal.

In conclusion, under current uses the COCs identified in soil/sediment at the JP-4 Spill site pose only a minimal, if any, potential threat to human health. Based on the human health risk assessment, remedial actions are not necessarily warranted at the site.

4.1.5 Ecological Risk Assessment

The objective of the ERA was to estimate the potential impacts of chemicals detected at the installation to aquatic and terrestrial plants and animals. A summary of the methods used to assess potential ecological impacts is presented in Section 2.4.2.

4.1.5.1 Chemicals of Concern. COCs for the ERA were selected based on the average installation-wide concentration of chemicals detected at the Barter Island sites. Only sites where useable habitat exists that were likely used by ecological receptors were included in the ecological risk evaluation. The JP-4 Spill (SS21) site was determined not to consist of usable habitat for ecological receptors because the contaminated portion of the site consists mostly of gravel pad. In addition, the site is adjacent to an active road and tank farm.

The tundra area to the east of sample SS21-S03 (Figure 4-1) could potentially be used by ecological receptors. The ERA conducted for similar concentrations of contaminants detected at the site, however, determined there was no risk to ecological receptors. Therefore, there does not appear to be a risk to ecological receptors even if receptors did use the site.

4.1.5.2 Summary of Ecological Risk Assessment. The JP-4 Spill site was not evaluated in the ERA because it did not provide suitable habitat for potential ecological receptors. As a result, exposures to COCs of the representative species at this site were not expected.

4.1.6 Conclusions and Recommendations

Sampling and analyses have determined that the JP-4 Spill (SS21) site is contaminated with petroleum hydrocarbons (DRPH and GRPH) and low levels of BTEX compounds. In addition, low levels of VOCs and SVOCs associated with JP-4 were detected in site soils. The contaminated area at the site is the gravel pad located along a section of the JP-4 pipeline. The source of contamination is likely to be a break in the JP-4 fuel line that was reported during grading operations.

Migration of contaminants from the area of the break in the JP-4 line to downgradient locations appears to have occurred. A soil sample collected approximately 100 feet east of the suspected source area contained petroleum hydrocarbons. Because the pipeline is within a gravel drainage ditch, seasonal water flow may contribute to the potential migration of contaminants.

The risk assessment concluded that risks posed to human health and ecological receptors by site contaminants are minimal given current or future site uses. The potential human health risks at the site are not of a magnitude that normally requires remedial action. Therefore, under current site conditions and considering the findings of the risk assessment, remediation of the site is not necessarily warranted.

Levels of petroleum compounds detected at the site exceed ADEC guidance cleanup levels but the extent of contamination is not clearly defined. Therefore, the site is being recommended for additional sampling in order to more fully characterize the extent of petroleum hydrocarbon contamination.

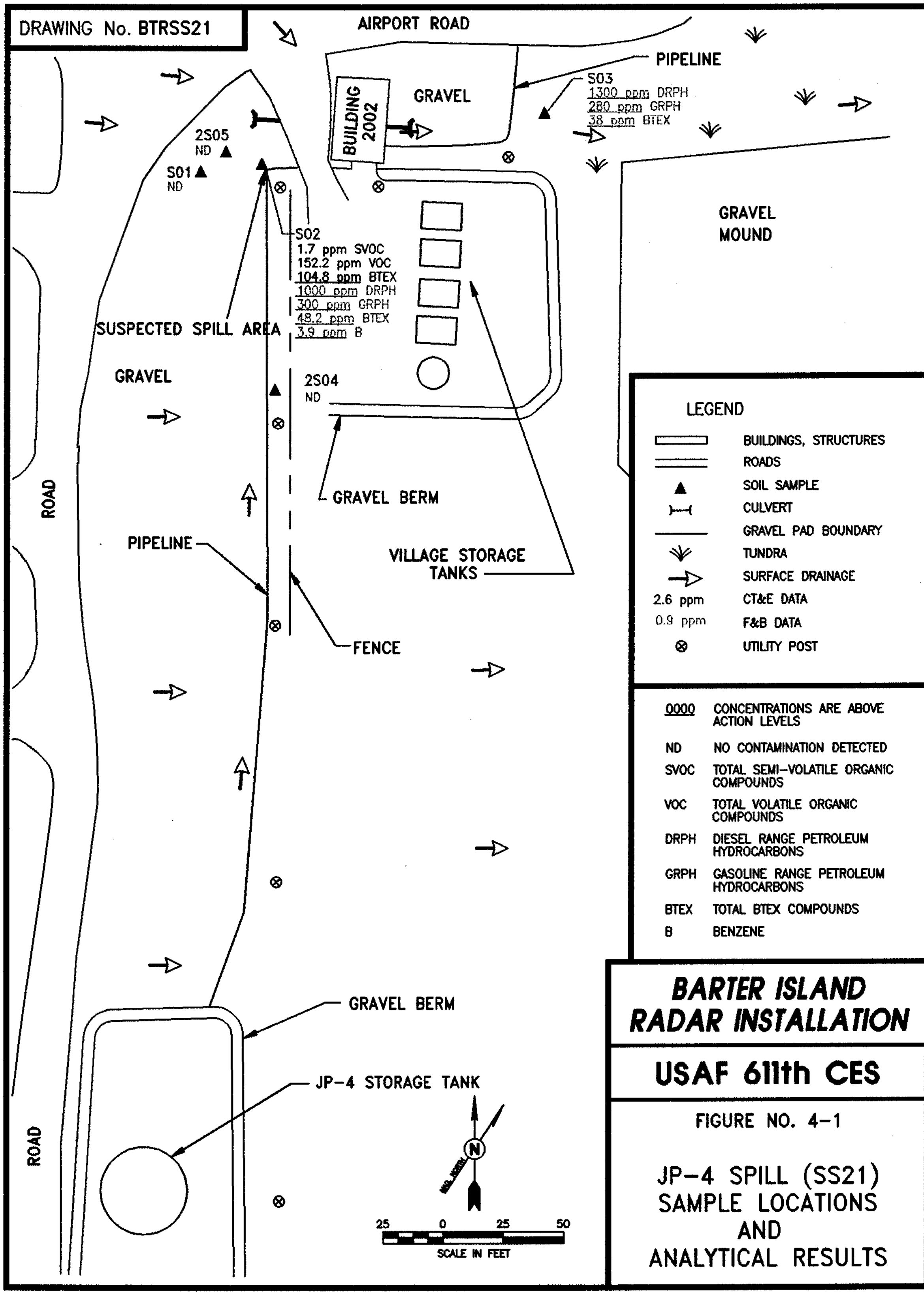

FIGURE NO. 4-1

JP-4 SPILL (SS21) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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TABLE 4-1. JP-4 SPILL ANALYTICAL DATA SUMMARY

Installation: Barter Island
Site: JP-4 Spill (SS21)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks	
					S01 Composite	S02	S03	2S04	2S05	AB02	EB05	TB05		
Laboratory Sample ID Numbers					364	366 4301-11	369	1692	1694	315 4303-1	392/332 4303-5	375	#3&4-82493 #1&2-82493 4303	#6-82393 #5-9593 #3&4-9693 #1&2-82493 4301
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-10	50-100	500[a]	9.55-1,150	<50J[b]	1,000J[b]	1,300J[b]	<100J[b]	<100J[b]	NA	<1,000[b]	NA	NA	<50J
GRPH	0.2-0.4	2-4	100	<0.400-<9.0	<2R[b]	300J[b]	280J[b]	<4J[b]	<2J[b]	<100J[b]	<100J[b]	<50J[b]	<50J-<100J	<2J
RRPH (Approx.)	10-20	100-200	2,000[a]	<480	<110	<100	<100	<200	<200	NA	<1,000	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.10R	48.2JN	38J	<0.20	<0.15					
Benzene	0.002-0.004	0.02-0.04	0.5	<0.200-<0.300	<0.02R	3.9JN	<0.04	<0.04	<0.03	<1	<1	<1	<1	<0.02J
Toluene	0.002-0.004	0.02-0.04		<0.200-<0.300	<0.02R	7.3JN	4	<0.04	<0.03	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002-0.004	0.02-0.04		<0.200-<0.300	<0.02R	10JN	10J	<0.04	<0.03	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004-0.008	0.04-0.08		<0.400-<0.600	<0.04R	27JN	24J	<0.08	<0.06	<2	<2	<2	<2	<0.04
HVOC 8010	0.004-0.02	0.04-0.2		<0.5J	<0.2R	<0.2	<0.04	<0.2	<0.1	<1	<1	<1	<1	<0.02J-<0.1
VOC 8260														
n-Butylbenzene	0.020	0.200		<0.025-<0.500	NA	4.20	NA	NA	NA	<1	<1	NA	<1	<0.020
sec-Butylbenzene	0.020	0.200		<0.025-<0.500	NA	1.94	NA	NA	NA	<1	<1	NA	<1	<0.020
tert-Butylbenzene	0.020	0.200		<0.025-<0.500	NA	0.345	NA	NA	NA	<1	<1	NA	<1	<0.020

□ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification."
R Result has been rejected.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE 4-1. JP-4 SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island   Matrix: Soil
Site: JP-4 Spill (SS21)   Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks	
					S01 Composite	S02	S03	2S04	2S05	AB02	EB05	TB05		
Laboratory Sample ID Numbers					364	366 4301-11	369	1692	1694	315 4303-1	392/332 4303-5	375	4303	#6-82393 #5-9593 4301
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
Ethylbenzene	0.020	0.200		<0.025-<0.500	NA	11.8	NA	NA	NA	<1	<1	NA	<1	<0.020
Isopropylbenzene	0.020	0.200		<0.025-<0.500	NA	2.25	NA	NA	NA	<1	<1	NA	<1	<0.020
p-Isopropyltoluene	0.020	0.200		<0.025-<0.500	NA	2.56	NA	NA	NA	<1	<1	NA	<1	<0.020
Naphthalene	0.020	0.200		<0.025-<0.500	NA	5.54	NA	NA	NA	<1	<1	NA	<1	<0.020
n-Propylbenzene	0.020	0.200		<0.025-<0.500	NA	3.26	NA	NA	NA	<1	<1	NA	<1	<0.020
Toluene	0.020	0.200		<0.025-<0.500	NA	24.0	NA	NA	NA	2.2	2.3	NA	<1	<0.020
1,2,4-Trimethylbenzene	0.020	0.200		<0.025-<0.500	NA	18.1	NA	NA	NA	<1	<1	NA	<1	<0.020
1,3,5-Trimethylbenzene	0.020	0.200		<0.025-<0.500	NA	9.16	NA	NA	NA	<1	<1	NA	<1	<0.020
Xylenes (Total)	0.040	0.400		<0.050-<1.000	NA	69.0	NA	NA	NA	<2	<2	NA	<2	<0.040
Total BTEX			15	<0.125-<2.500	NA	104.8	NA	NA	NA					
SVOC 8270														
2-Methylnaphthalene	0.200	0.200		<0.230-<3.50	NA	1.42	NA	NA	NA	NA	<11	NA	<10	<0.200
Naphthalene	0.200	0.200		<0.230-<3.50	NA	0.274	NA	NA	NA	NA	<11	NA	<10	<0.200
Pesticides	0.001-0.05	0.01-0.5		<0.001-<0.100	<0.01J-<0.5J	NA	NA	NA	NA	NA	<0.2-<10	NA	NA	<0.01-<0.5
TOC					NA	2,200	NA	NA	NA	NA	<5,000J	NA	<5,000	NA

☐ CT&E Data.
■ F&B Data.
NA Not analyzed.
J Result is an estimate.

TABLE 4-2. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE JP-4 SPILL (SS21)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a]		ARAR[b]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
JP-4 Spill	Soil	DRPH	1,300	mg/kg	9.55-1,150	--	--	500[c]	YES
(SS21)		GRPH	300	mg/kg	<0.400-<9	--	--	100[c]	YES
		Benzene	3.9	mg/kg	<0.020-<0.500	2.2	--	0.5[c]	YES
		n-Butylbenzene	4.20	mg/kg	<0.025-<0.500	--	--	--	NO
		sec-Butylbenzene	1.94	mg/kg	<0.025-<0.500	--	--	--	NO
		tert-Butylbenzene	0.345	mg/kg	<0.025-<0.500	--	--	--	NO
		Ethylbenzene	11.8	mg/kg	<0.020-<0.500	--	2,700	--	NO
		Isopropylbenzene	2.25	mg/kg	<0.025-<0.500	--	--	--	NO
		p-Isopropyltoluene	2.56	mg/kg	<0.025-<0.500	--	--	--	NO
		Naphthalene	5.54	mg/kg	<0.025-<3.50	--	100	--	NO
		n-Propylbenzene	3.26	mg/kg	<0.025-<0.500	--	--	--	NO
		Toluene	24.0	mg/kg	<0.020-<0.500	--	5,400	--	NO
		1,2,4-Trimethylbenzene	18.1	mg/kg	<0.025-<0.500	--	--	--	NO
		1,3,5-Trimethylbenzene	9.16	mg/kg	<0.025-<0.500	--	--	--	NO
		Xylenes	69.0	mg/kg	<0.040-<1.000	--	54,000	--	NO
		2-Methylnaphthalene	1.42	mg/kg	<0.230-<3.50	--	--	--	NO

a Risk-Based Screening Level.
b Applicable or Relevant and Appropriate Requirement.
c ADEC 1991.

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5.0 REMEDIAL INVESTIGATION - REMEDIAL ACTION SITES

This section of the RI/FS presents results from RI sampling and analysis activities for each of the four Barter Island sites where remedial action may be warranted. The four sites considered for remedial action and discussed in this section are the POL Catchment (LF03), Heated Storage (SS13), Garage (SS14), and White Alice Facility (SS16). Each of the sites is presented individually in Sections 5.1 through 5.4. (Note: figures and tables are presented at the end of each section.) The information presented for each site includes site background, field sampling and analytical results, potential migration pathways, human health and ecological risk assessment summaries, and conclusions and recommendations. The site-by-site discussions in this section are intended to provide the reader with all site information needed to understand the site conditions and make decisions regarding appropriate action for each of the sites.

Photographs of the Barter Island installation and the sites investigated during the RI are presented in Appendix B. Data tables presented in this section list analytical results from samples in which chemicals were detected above quantitation limits. Complete laboratory analytical data sheets for each sample, including quantitation limits for non-detected analytes, are presented in Appendix F.

5.1 POL CATCHMENT (LF03)

5.1.1 Site Background

The POL Catchment site (LF03) is an almost rectangular-shaped tundra area surrounded by a gravel berm. The site is located north of the module trains and directly east of the POL Tanks (ST17). The POL Tank area is bulk fuel storage for arctic grade diesel fuels. The tundra area within the gravel berm is approximately 200 feet by 130 feet. The east portion of the bermed area consists of tundra and is dominated by a large pond. A small portion of the west side of the site consists of gravel, and there is a small stained area in the gravel at the base of the western berm. The POL Catchment serves as a secondary containment unit for petroleum hydrocarbons released from the POL Tanks (ST17) resulting from tank leaks and fuel spills.

Previous sampling, conducted in 1986, 1987 and 1990 by Air Force contractors, detected petroleum hydrocarbons and VOCs in surface water at the POL Catchment site. A detailed list of source areas, contaminants, and concentrations previously detected is presented in the RI/FS Work Plan (U.S. Air Force 1993a).

The site-specific environmental setting describing the topography, surface water drainage, and soil types is presented in the discussion of potential migration pathways, Section 5.1.3.

5.1.2 Field Sampling and Analytical Results

This section describes the RI sampling and analytical results for samples collected at the POL Catchment site. The discussion presents a review of laboratory data, data summary tables, contaminants identified, contaminant trends, and information on suspected source areas.

5.1.2.1 Summary of Samples Collected. A total of 16 samples was collected from gravel and tundra areas, ponds, and streams at the site. These consisted of four soil, nine sediment, and three surface water samples. Table 2-2 presents a detailed summary of the samples collected and the analyses performed during the 1993 RI field activities. Locations of all samples collected at the POL Catchment (LF03) and a summary of analytical results above background levels are presented in Figure 5-1.

Four soil samples were analyzed for DRPH, GRPH, BTEX, and VOCs. In addition, one soil sample was analyzed for RRPH.

Nine sediment samples were analyzed for DRPH, GRPH, and BTEX. In addition, four samples were analyzed for VOCs (8010). Two samples were analyzed for RRPH, VOCs (8260), and SVOCs, and one sample was analyzed for TOC.

Three surface water samples were analyzed for DRPH, GRPH, and BTEX. In addition, two samples were analyzed for VOCs (8260), SVOCs, TOC, TSS, and TDS. One sample was analyzed for VOCs (8010).

5.1.2.2 Analytical Results. The data summary table (Table 5-1) presents analytical results for all samples collected at the site. Detection and quantitation limits, action levels, associated laboratory and field blanks, and background analytical results are presented for each of the analyses. Background levels are listed to allow direct comparison of naturally occurring organic compounds with samples collected from the site. Sample locations and analytical results for the samples at the site are illustrated in Figure 5-1. All organic compounds detected are presented on the figure except when they were a result of laboratory contamination or field decontamination procedures. The exceptions are presented on the data summary table.

The following section presents a discussion of organic compounds detected above background levels at the site. A discussion of TDS, TSS, and TOC is included.

Organics. Organic compounds detected in soil and sediment samples collected at the site included DRPH, GRPH, RRPH, BTEX, nine other VOCs, and SVOCs. DRPH were detected in eleven samples at concentrations ranging from 4.76 to 28,600 mg/kg. GRPH were detected in six samples ranging from 0.429 to 78.5 mg/kg. RRPH were detected in one sample, LF03-S01, at 180 mg/kg. BTEX compounds were detected at low levels in five samples. Total BTEX concentrations ranged from 0.161 to 6.39 mg/kg; xylenes were the primary component. Nine other VOCs were detected in three soil/sediment samples (LF03-S01, LF03-SD01 and LF03-SD07) at concentrations ranging from 0.255 to 5.42 mg/kg; the primary compounds were tetrachloroethene (5.42 mg/kg) and n-butylbenzene (3.7 mg/kg). One SVOC, 2-methylnaphthalene, was detected in sediment sample LF03-SD01 at 3.44 mg/kg.

In surface water samples, organic compounds detected include DRPH, GRPH, BTEX, and eight other VOCs. DRPH were detected in all three samples ranging from 612 to 1,770 µg/L. GRPH, BTEX, and eight other VOCs were detected in one sample, LF03-SW01. GRPH were detected at 367 µg/L. BTEX compounds ranged from 2.7 (benzene) to 38.4 µg/L (xylenes). The primary VOCs detected in surface water were naphthalene (35 µg/L), 1,2,4-trimethylbenzene (19 µg/L), and 1,3,5-trimethylbenzene (13 µg/L); all are common components of diesel fuel. Five other VOCs were detected at low concentrations ranging from 1.0 to 3.6 µg/L.

In addition, one VOC that was detected in a surface water sample was detected at similar concentrations in the field blanks and background samples. This compound, 1,2-dichloroethane, was detected at concentrations ranging from 4.4 to 4.6 µg/L in the environmental samples, 1.2 to 2.2 µg/L in the field blanks, and 1.3 to 3.2 µg/L in the background samples. These detections were assumed to be the result of field decontamination procedures. The hexane and methanol used in the decontamination procedures may have contained impurities including 1,2-dichloroethane.

Inorganics. Metals were not a concern at the site, and no metals analyses were performed.

TOC was reported at 19,500 mg/kg in sediment sample LF03-SD07. TOC was reported at 48,101 and 21,000 µg/L in surface water samples LF03-SW01 and LF03-SW03, respectively. TSS were reported at 71,000 and 12,000 µg/L, and TDS were reported at 847,000 and 637,000 µg/L in the same respective surface water samples.

5.1.2.3 Summary of Site Contamination. Previous sampling conducted at the POL Catchment (LF03) detected petroleum compounds and low concentrations of solvents in surface water. The results and the sources of previous sampling efforts are presented in the RI/FS Work Plan (U.S. Air Force 1993a). The quality of the previous IRP sampling data is unknown as is the data validation, if any, that these data have undergone.

TPH were previously detected at 4,400 and 2,200 µg/L in surface water samples collected in 1987 and at 500 µg/L in a surface water sample collected in 1990 inside the bermed area of the POL Catchment. Current results (1,770 and 367 µg/L) indicate the presence of DRPH in the surface water has decreased since 1987 and is at concentrations similar to those of the 1990 IRP sampling. Current results also indicate VOCs in the surface water; the VOCs detected are predominantly components of diesel fuel. Petroleum hydrocarbons were not detected in previous soil samples collected at the POL Catchment site; however, DRPH, GRPH, toluene, ethylbenzene, and xylenes were detected in the soil/sediment samples collected during the 1993 RI activities.

A comparison of historical data and current project data indicates that the level of petroleum and VOC contamination in surface water at the POL Catchment site is similar to that detected in the past. However, higher concentrations of petroleum compounds in soil and sediment were detected during the 1993 RI. Differences between past and current data are likely to be a result of more extensive sampling during the 1993 RI. The human health and ecological risks associated with the chemicals detected at the site are presented in Sections 5.1.4 and 5.1.5.

The chemicals detected at the POL Catchment site are suspected to be a result of releases from the POL Tanks (ST17) or product piping. Releases from the POL Tanks may have migrated into the POL Catchment as depicted in the illustration of the surface water drainage presented in Figure 5-1.

Significant DRPH concentrations were detected in soil, sediment, and surface water samples collected within the bermed area of POL Catchment site. Significant concentrations of petroleum compounds were also detected in a small stained gravel area adjacent to the west berm within the site. Lower levels of petroleum compounds were detected in samples collected in the tundra area outside the bermed catchment basin. It is suspected that some of the contaminants have been carried by surface runoff through a culvert to the east side of the north-south POL Catchment berm.

Based on field data, source of contamination, and concentration of the contaminants, significantly contaminated soil and sediment appear to be limited to the gravel bermed area of the site. This area includes approximately 27,000 square feet of tundra and 36 square feet of gravel. Low levels of petroleum compounds were detected outside the berm in the marshy drainage indicating that migration of contaminants has occurred.

5.1.3 Migration Pathways.

This section describes the topography and stratigraphy of the site and the migration potential of contaminants from the site. A discussion of receptors and chemical concentrations at receptors is included.

5.1.3.1 Topography and Stratigraphy. The POL Catchment area is dominated by a large surface water pool in the catchment basin (Figure 5-1). This pool, when it rises sufficiently, drains into marshy tundra via a culvert in the eastern berm. Once in the tundra, surface water is controlled by an indistinct, marshy drainage that leads approximately 100 feet into another site (SD08, the Contaminated Ditch). Except for berms, very little relief is expressed at the site. The catchment area is generally tundra within the bermed area. The site is surrounded by marshy tundra on the north and east sides.

During the 1993 RI, permafrost was located at a depth of approximately two and a half feet in tundra areas and four feet under gravel pads. Gravel pad material consisted of the typical gravels and sands associated with these features, and subsurface tundra materials were of the typical stratigraphy found at Barter Island (Section 2.4.4.2).

5.1.3.2 Migration Potential.

Subsurface Migration. Topography at the site indicates that any subsurface drainage should be to the east out of the catchment area, into the tundra, and to the incised stream. To leave the catchment basin, active layer water would have to pass through the gravel berm. This may restrict subsurface migration to periods when the catchment area has several feet of water, or eliminate it altogether, because a mound of permafrost may be present under the berm roads

(Figure 2-6). Such a mound would act as a subsurface dike and trap water within the catchment area.

Surface Migration. Surface water bodies consist of a large but shallow pool of water (in summer months) in the catchment area, the marshy drainage, and the offsite downgradient stream running to the Contaminated Ditch (SD08) site.

The catchment area receives surface water drainage from the POL Tanks (ST17) site via two culverts under berms (along the west side of the catchment area). The catchment area drains to the east via a culvert under a berm road. This culvert leads through a marshy, indistinct drainage pathway into the Contaminated Ditch stream. The marshy drainage lacks a distinct channel and is located in generally saturated tundra. This pathway should be active mainly in the spring, when sufficient runoff collects in the catchment basin to reach the level of the discharge culvert.

Air Transport. Air transportation is not considered to be a significant mode of migration at the site (Section 2.4.4.5).

Summary of Migration Potential. The primary migration pathway at the POL Catchment site (LF03) is a culvert leading from the bermed area of the site to a marshy, poorly defined tundra stream that drains to the Contaminated Ditch (SD08). Although petroleum compounds and low concentrations of solvents were detected in the catchment basin, analytical data suggest that only relatively low levels of these compounds are migrating offsite. These compounds were not detected in water samples from the downgradient streams of the Contaminated Ditch. Therefore, surface water migration has occurred and continues to be a potential pathway; however, downgradient samples indicate migration of contaminants is not currently occurring. Subsurface active layer water is probably not a significant potential migration pathway.

5.1.3.3 Receptors and Chemical Concentrations at Receptors.

Human Receptors. Potential human receptors at the POL Catchment site include Air Force contractor personnel working at the station, visitors to the station, and an occasional local visitor passing the site to get to recreational or subsistence lands. Human receptors could potentially be exposed to the chemicals detected in surface water and soil/sediments at the site. The primary routes of potential exposures at the site are direct contact with soil/sediment, incidental ingestion of soil/sediment, and ingestion of surface water. Because groundwater and air at the Barter Island sites are not considered complete pathways of exposure, these media are not evaluated as potential pathways to human receptors.

The Barter Island Risk Assessment (U.S. Air Force 1996) evaluates in detail the risks to human health from all COCs detected at the site. The potential receptor groups were selected based on their likelihood of exposure to contaminants at the site and include DEW Line workers at the installation, and native adults and children who may visit the site. The estimated exposure point concentrations for human receptors are based on the maximum concentration of each chemical detected at the site. The potential risks to human health associated with chemicals detected at the site are presented in Section 5.1.4.

Ecological Receptors. Ecological receptors were evaluated in detail in the Barter Island Risk Assessment (U.S. Air Force 1996) to determine if plants and animals could potentially be impacted by the chemicals detected at the Barter Island installation. Because of the diversity of the plants and animals in the area of the Barter Island installation, a set of representative species was selected in the ERA for detailed evaluation. The species include plants, aquatic invertebrates, fish, birds, and mammals. These receptors were selected based on the species' likelihood of exposure given their preferred habitat and feeding habits. The representative species encompass a range of ecological niches in order to achieve the best characterization of the ecosystems being examined and are presented in Table 2-6.

The estimate of chemical concentrations at the ecological receptors was based on the average site-wide concentration of each COC. This approach was appropriate because few of the representative species would inhabit only one distinct site at the installation; they are more likely to be exposed to the mix of chemicals and concentrations detected on all the sites at Barter Island. The potential ecological risks associated with the chemicals detected at the site are presented in Section 5.1.5.

5.1.4 Human Health Risk Assessment

This section presents a summary of the potential human health risks associated with the chemicals detected at the POL Catchment (LF03) site. The purpose of the human health risk assessment is to quantify the excess lifetime cancer risk and/or the noncancer hazard (reported as hazard index) from the chemicals detected at the site.

This summary presents the COCs at the site, the pathways by which human receptors may be exposed to site chemicals, potential risks to human health posed by each chemical through each exposure pathway, the significance of the risk and/or hazard estimate, and a comparison of site chemical concentrations to ARARs. The methods and assumptions used in calculating hazards and risks are presented in Section 2.4.1.

5.1.4.1 Chemicals of Concern. At the POL Catchment (LF03), COCs identified in soil/sediment matrix are DRPH and tetrachloroethane. DRPH were selected because concentrations detected exceeded an ARAR, and tetrachloroethane was selected because concentrations exceeded the RBSL.

DRPH, GRPH, and benzene were determined to be COCs in surface water at the site because the maximum concentrations detected exceeded the associated background concentrations and the RBSLs.

Table 5-2, Identification of COCs at the POL Catchment, presents the maximum concentrations of chemicals detected at the site and associated background concentrations, RBSLs, and ARARs, and identifies COCs selected in the risk evaluation.

5.1.4.2 Exposure Pathways and Potential Receptors. Because COCs were identified for soil/sediment and surface water at the site, the potential risks associated with ingestion of soil/sediment and surface water were evaluated in the risk assessment.

Three potential receptor groups were evaluated in the risk assessment: an adult assigned to a DEW Line installation (worker), an adult inhabitant of communities in the North Slope of Alaska (native), and a child living in a North Slope community (child).

5.1.4.3 Risk Characterization.

Noncancer Hazard and Cancer Risk Associated with Soils and Sediments. The noncancer hazard associated with the ingestion of soil/sediment at the POL Catchment (LF03) site by a hypothetical native northern adult/child is 0.434, and by a DEW Line worker is 0.021, based on the maximum concentrations of the COCs. The presence of DRPH accounts for more than 99 percent of the quantifiable noncancer hazard for these receptor/pathway combinations.

The excess lifetime cancer risk associated with the ingestion of soil at the site by a hypothetical native northern adult/child is 5×10^{-8}, and by a DEW Line worker is 2×10^{-9}, based on the maximum concentrations of the COCs. The presence of tetrachloroethane accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations. (Note: excess lifetime cancer risks, and noncancer hazards and the significance of reported values are discussed in Section 2.4.1.)

Noncancer Hazard and Cancer Risk Associated with Surface Water. The noncancer hazard associated with the ingestion of surface water at the POL Catchment site by a hypothetical native northern adult or a DEW Line worker is 0.338, based on the maximum concentrations of the COCs. The presence of DRPH and GRPH accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations.

The excess lifetime cancer risk associated with the ingestion of surface water at the site by a hypothetical native northern adult is 1×10^{-5}, and by a DEW Line worker is 1×10^{-6}, based on the maximum concentrations of the COCs. The presence of GRPH and benzene accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

5.1.4.4 Summary of Human Health Risk Assessment. The potential risks and hazards associated with the soil/sediment at the POL Catchment are the low noncancer hazards (hazard indices of 0.02 and 0.4), and very low cancer risk associated with tetrachloroethane. These noncancer hazards and cancer risks are below the threshold values (noncancer hazard <1 and cancer risks $<1 \times 10^{-6}$) (EPA 1991c). In addition, the hazards and risks were calculated conservatively based on a residential scenario. Therefore, the noncancer and cancer risks associated with soil/sediment at the site are minimal.

The hazard index of 0.3 is associated with DRPH and GRPH in surface water at the site. The noncancer risk is, therefore, minimal. The cancer risk for a hypothetical native adult is 1×10^{-5}. This cancer risk exceeds the 1×10^{-6} threshold level and indicates a potential cancer risk. This potential risk was calculated assuming the affected surface water would be used as a sole-source water supply for 180 days per year. Based on site-specific information, the chemicals in surface water do not currently pose a health hazard nor are they likely to pose a hazard in the future. The surface water expressions at the site are frozen most of the year; many are only intermittently filled with water during the summer months. The surface water at the site is not known to be

used as a water supply now, nor has it been used in the past. In addition, remedial action is not generally warranted at sites where the cancer risk is below 1 x 10^{-4} (EPA 1991c). In conclusion, under current uses the COCs identified in surface water at the POL Catchment site pose only a minimal, if any, potential threat to human health. Based on the human health risk assessment, remedial actions are not warranted at the site. In the unlikely event that surface water at the site is used as a sole-source drinking water supply in the future, a potential noncancer hazard to human health could exist if conditions remain constant.

5.1.5 Ecological Risk Assessment

The objective of the ERA is to estimate the potential impacts of chemicals detected at the installation to aquatic and terrestrial plants and animals. A summary of the methods used to assess potential ecological impacts is presented in Section 2.4.2.

5.1.5.1 Chemicals of Concern. COCs were selected based on criteria presented in Section 3.1 of the ERA. The average installation-wide concentrations of COCs were used to calculate the risk estimates. DRPH was the only COC detected in surface water at the POL Catchment site; DRPH, ethylbenzene, and xylenes were detected in soils/sediments. DRPH in surface water was the only COC associated with potential risk at the POL Catchment site.

5.1.5.2 Exposure Pathways and Potential Receptors. Potential exposure pathways for terrestrial and aquatic organisms include direct contact with, and ingestion of, contaminated soil/sediment and/or surface water. The most significant route of exposure for plants is direct contact with soil. Aquatic organisms such as fish and invertebrates are primarily exposed through direct contact with surface water, and average surface water concentrations were used to evaluate potential exposures. They may also be exposed to COCs through ingestion of plant and animal items in their diet, and incidental ingestion of soil/sediment while foraging, although these pathways are considered less significant and are not used to calculate HQs. Birds and mammals may be exposed to COCs through ingestion of surface water, ingestion of plant and animal diet items (although only ingestion of plant matter was quantified in the estimated exposure equation), and incidental ingestion of soil/sediment.

The potential ecological receptors evaluated in the risk assessment include plants, aquatic organisms, birds, and mammals likely to occur along the Arctic Coastal Plain. Representative species from these receptor groups were selected based primarily on the species' likelihood of exposure, preferred habitat, and feeding habits. Species that may be particularly sensitive to environmental impacts, such as threatened and endangered species, are considered on an individual basis if present at or near the installation. Spectacled and Steller's eiders have been identified in the vicinity of the Barter Island installation, although there is a low probability that either species is currently nesting or raising broods on the Barter Island sites (Alaska Biological Research 1994). The ERA evaluation included the spectacled eider, and this evaluation was also used to evaluate any potential risk to Steller's eiders should they be found at the installation. The species evaluated in the ERA are listed in Table 2-6.

5.1.5.3 Risk Characterization. Potential risks at the POL Catchment site are related to the elevated DRPH HQ of 3.0 for *Daphnia* spp. HQs for the remaining COCs are below 1.0 for the other representative species.

5.1.5.4 Summary of Ecological Risk Assessment. The elevated HQ for *Daphnia* spp. indicates that there may be risk associated with DRPH at this site, although the magnitude of the HQ (three) is evidence that the risk is relatively low and may affect just the organisms present at the "hot spot" locations, rather than the entire *Daphnia* population.

The ERA indicates that, although there is an instance of potential risk to an individual species (Daphnia), overall the potential risks presented by the chemicals detected at the site are low.

5.1.6 Conclusions and Recommendations

Sampling and analyses have determined that the POL Catchment (LF03) site is contaminated primarily with petroleum hydrocarbons. The contaminated areas at the site are soil/sediment and surface water within the bermed portion of the site. In addition, a small stained area of gravel located in the western portion of the site is contaminated with petroleum hydrocarbons. The likely sources of contamination are spills and/or leaks of diesel fuel from the tank farm just to the west of the site.

Migration of contaminants from the site appears to have occurred to a limited degree through a culvert that leads from the catchment basin to the tundra area to the east. Relatively low levels of DRPH were detected in soil/sediments and surface water in samples from this tundra area. This tundra area drains to the Contaminated Ditch site, and no contaminants were detected from the down-gradient areas of the ditch in soil/sediment and surface water samples.

The risk assessment concluded that risks posed to human health and ecological receptors by site contaminants are minimal given current site uses. Under a future scenario, using the surface water in the catchment basin as a drinking water supply results in a potential risk to human health. This risk, however, is not of a magnitude that normally requires remedial action. Therefore, under current site conditions and considering the findings of the risk assessment, remediation of the site is not necessarily warranted.

Levels of petroleum compounds (primarily diesel) detected at the site significantly exceed ADEC guidance cleanup levels, and migration of contaminants has occurred. Therefore, the site is recommended for remedial action. The contaminated area at the site consists of 5 cubic yards of gravel and 2,500 cubic yards of tundra. Passive bioremediation is the recommended alternative for remediation for both the gravel and tundra areas of the site. A complete description and evaluation of the remedial alternatives considered for this site and the rationale for the selected alternative is presented in the Feasibility Study, Section 6.0.

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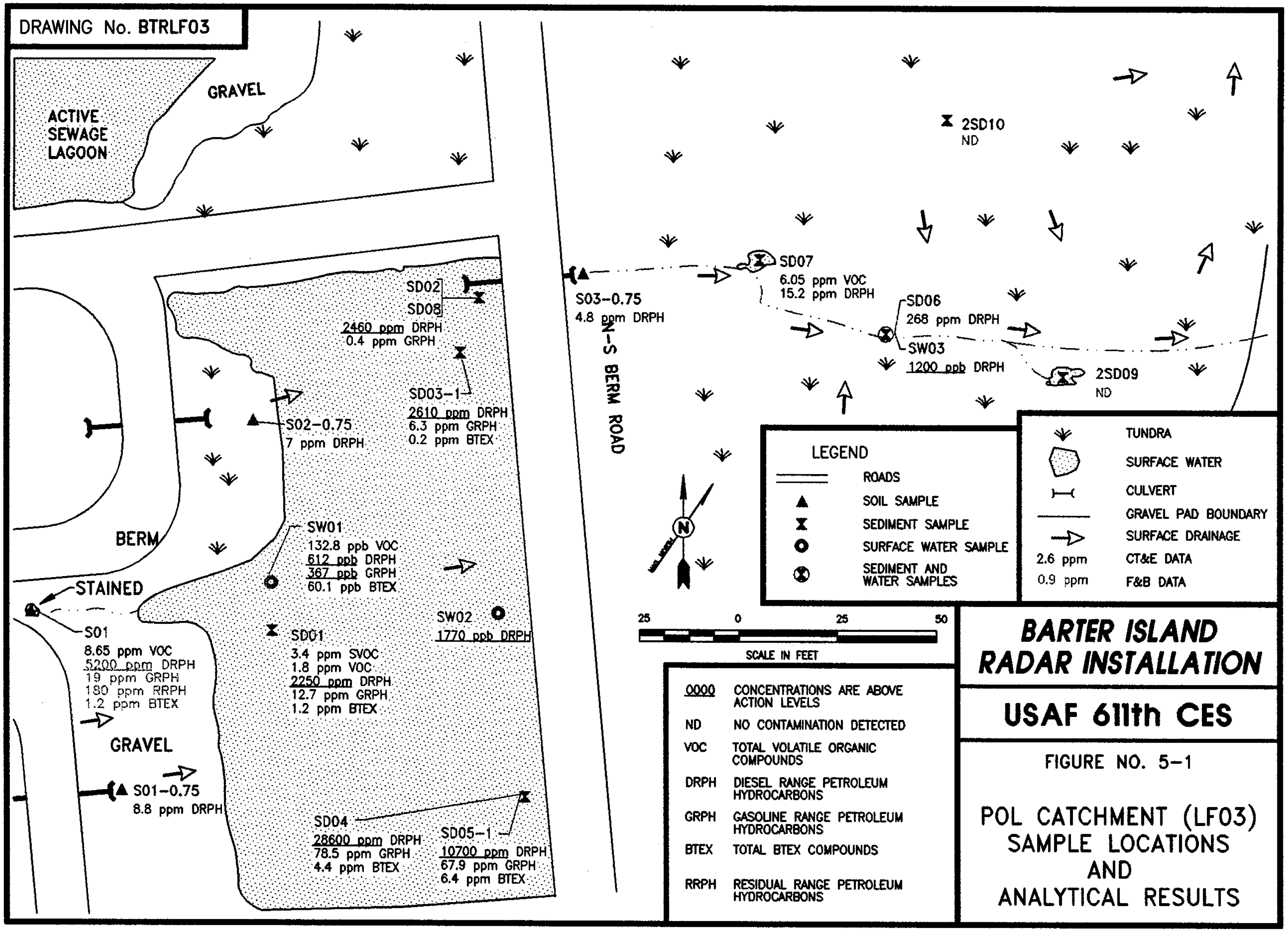
DRAWING No. BTRLF03
ACTIVE SEWAGE LAGOON
GRAVEL
BERM
STAINED
S01
8.65 ppm VOC
5200 ppm DRPH
19 ppm GRPH
180 ppm RRPH
1.2 ppm BTEX
GRAVEL
S01-0.75
8.8 ppm DRPH
SD02
SD08
2460 ppm DRPH
0.4 ppm GRPH
S02-0.75
7 ppm DRPH
SD03-1
2610 ppm DRPH
6.3 ppm GRPH
0.2 ppm BTEX
SW01
132.8 ppb VOC
612 ppb DRPH
367 ppb GRPH
60.1 ppb BTEX
SD01
3.4 ppm SVOC
1.8 ppm VOC
2250 ppm DRPH
12.7 ppm GRPH
1.2 ppm BTEX
SW02
1770 ppb DRPH
SD04
28600 ppm DRPH
78.5 ppm GRPH
4.4 ppm BTEX
SD05-1
10700 ppm DRPH
67.9 ppm GRPH
6.4 ppm BTEX
N-S BERM ROAD
S03-0.75
4.8 ppm DRPH
SD07
6.05 ppm VOC
15.2 ppm DRPH
SD06
268 ppm DRPH
SW03
1200 ppb DRPH
2SD10
ND
2SD09
ND
LEGEND
ROADS
SOIL SAMPLE
SEDIMENT SAMPLE
SURFACE WATER SAMPLE
SEDIMENT AND WATER SAMPLES
TUNDRA
SURFACE WATER
CULVERT
GRAVEL PAD BOUNDARY
SURFACE DRAINAGE
2.6 ppm CT&E DATA
0.9 ppm F&B DATA
25 0 25 50
SCALE IN FEET
0000 CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND NO CONTAMINATION DETECTED
VOC TOTAL VOLATILE ORGANIC COMPOUNDS
DRPH DIESEL RANGE PETROLEUM HYDROCARBONS
GRPH GASOLINE RANGE PETROLEUM HYDROCARBONS
BTEX TOTAL BTEX COMPOUNDS
RRPH RESIDUAL RANGE PETROLEUM HYDROCARBONS
BARTER ISLAND RADAR INSTALLATION
USAF 611th CES
FIGURE NO. 5-1
POL CATCHMENT (LF03) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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TABLE 5-1. POL CATCHMENT ANALYTICAL DATA SUMMARY

Installation: Barter Island   Matrix: Soil
Site: POL Catchment (LF03)   Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks						Lab Blanks	
					S01	S01-0.75	S02-0.75	S03-0.75	AB01	AB02	EB03	EB04	TB03	TB04		
Laboratory Sample ID Numbers					1290 4302-1	4216-7	4216-8	4216-9	4173-9 4197-6	315 4303-1	4213-4 4215-6	311 4302-10	4211-2	1346 4302-9	#3&4-92493 #3&4-83193 4302 4215/4213 4212/4211 4197/4173	#6-83193 #1&2-83193 4302 4216
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	9.55-1,150	5,200[b]	8.84[d]	6.95[d]	4.76[d]	NA	NA	<100	NA	NA	NA	<100	<4.00-<70J
GRPH	0.400	0.400	100	<0.4-<9.0	19J[b]	<0.400	<0.400	<0.400	NA	<100J[b]	<20	<100J[b]	NA	<100J[b]	<20-<100J	<0.400-<2J
RRPH (Approx.)	10-30	100-300	2,000[a]	<480	180	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	1.23J	<0.100	<0.100	<0.100								
Benzene	0.020	0.020	0.5	<0.020-<0.300	<0.02	<0.020	<0.020	<0.020	<1	<1	<1	<1	<1[c]	<1	<1	<0.020
Toluene	0.020	0.020		<0.020-<0.300	0.08	<0.020	<0.020	<0.020	1.2	<1	3.2	<1	<1[c]	<1	<1	<0.020
Ethylbenzene	0.020	0.020		<0.020-<0.300	0.05	<0.020	<0.020	<0.020	<1	<1	<1	<1	<1[c]	<1	<1	<0.020
Xylenes (Total)	0.040	0.040		<0.040-<0.600	1.1J	<0.040	<0.040	<0.040	<2	<2	<2	<2	<2[c]	<2	<2	<0.040
VOC 8010	0.020	0.020		<0.020-<0.300	NA	<0.020	<0.020	<0.020	<1-9.8	NA	NA	NA	NA	NA	<1	<0.020
VOC 8260																
n-Butylbenzene	0.020	0.200		<0.025-<0.500	3.70	NA	NA	NA	NA	<1	NA	<1	NA	<1	<0.020	<1
sec-Butylbenzene	0.020	0.200		<0.025-<0.500	1.62	NA	NA	NA	NA	<1	NA	<1	NA	<1	<0.020	<1
Ethylbenzene	0.020	0.200		<0.025-<0.500	0.313	NA	NA	NA	NA	<1	NA	<1	NA	<1	<0.020	<1
Isopropylbenzene	0.020	0.200		<0.025-<0.500	0.409	NA	NA	NA	NA	<1	NA	<1	NA	<1	<0.020	<1
p-Isopropyltoluene	0.020	0.200		<0.025-<0.500	1.69	NA	NA	NA	NA	<1	NA	<1	NA	<1	<0.020	<1
n-Propylbenzene	0.020	0.200		<0.025-<0.500	0.920	NA	NA	NA	NA	<1	NA	<1	NA	<1	<0.020	<1

□ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c BTEX determined by 8260 method analysis.
d The laboratory reported that the EPH pattern in this sample was not consistent with an unweathered middle distillate fuel.

TABLE 5-1. POL CATCHMENT ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: POL Catchment (LF03)

Matrix: Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples								Field Blanks			Lab Blanks	
					SD01	SD02 & SD08 (Replicates)		SD03-1	SD04-1	SD05	SD06	SD07	AB01	EB03	TB03		
Laboratory Sample ID Numbers					4216-11 4212-3	4219-13	4219-12	4215-5	4215-1	4215-4	4219-11	4213-3 4219-10	4173-9 4197-6	4213-4 4215-6	4211-2	4215 4213 4211	4219 4216 4215 4213 4212
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	9.55-1,150	2,250	1,940	2,460	2,610	28,600	10,700	268[e]	15.2J[d]	NA	<100	NA	<100	<4.00
GRPH	0.400	0.400-0.600	100	<0.4-<9.0	12.7	<0.500	0.429	6.30	78.5	67.9	<0.600	<0.400	NA	<20	NA	<20	<0.400
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	1.15	<0.100	<0.100	0.161	4.309	6.282	<0.150	<0.100					
Benzene	0.020	0.020-0.070	0.5	<0.020-<0.300	<0.070	<0.020	<0.020	<0.02	<0.035	<0.04	<0.030	<0.020	<2	<1	<1	<1	<0.020
Toluene	0.020	0.020-0.070		<0.020-<0.300	<0.070	<0.020	<0.020	<0.02	0.116B	0.108B	<0.030	<0.020	1.2	3.2	<1[c]	<1	<0.020
Ethylbenzene	0.020	0.020-0.070		<0.020-<0.300	0.323	<0.020	<0.020	0.034	0.739	0.982	<0.030	<0.020	<1	<1	<1[c]	<1	<0.020
Xylenes (Total)	0.040	0.040-0.140		<0.040-<0.600	0.827	<0.040	<0.040	0.127	3.57	5.30	<0.060	<0.040	<2	<2	<2[c]	<2	<0.040
VOC 8010	0.020	0.020-0.070		<0.020-<0.300	<0.070	<0.020	<0.020	NA	NA	NA	<0.030	<0.020	<1-9.8	NA	NA	<1	<0.020
VOC 8260																	
n-Butylbenzene	0.020	0.120-0.400		<0.025-<0.500	0.635	NA	NA	NA	NA	NA	NA	<0.120 J	<1	<1	<1	<1	<0.020
Methylene Chloride	0.020	0.120-0.400	90	<0.025-<0.500	<0.400	NA	NA	NA	NA	NA	NA	0.255JB	1.1	2.4	<1	<1	<0.020
Tetrachloroethene	0.020	0.120-0.400		<0.025-<0.500	<0.400	NA	NA	NA	NA	NA	NA	5.42J	<1	<1	<1	<1	<0.020
1,2,4-Trimethylbenzene	0.020	0.120-0.400		<0.025-<0.500	0.638	NA	NA	NA	NA	NA	NA	<0.120 J	<1	<1	<1	<1	<0.020
1,3,5-Trimethylbenzene	0.020	0.120-0.400		<0.025-<0.500	0.536	NA	NA	NA	NA	NA	NA	0.379J	<1	<1	<1	<1	<0.020

☐ CT&E Data.
NA Not analyzed.
B The analyte was detected in the associated blank samples.
J Result is an estimate.
a The action level for DRPH is based on conversations with ADEC; a final action level has not yet been determined.
c BTEX determined by 8260 method analysis.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.
e The laboratory reported that 183 mg/kg of the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE 5-1. POL CATCHMENT ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island — Matrix: Sediment
Site: POL Catchment (LF03) — Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples								Field Blanks			Lab Blanks	
					SD01	SD02 & SD08 (Replicates)		SD03-1	SD04-1	SD05	SD06	SD07	AB01	EB03	TB03		
Laboratory Sample ID Numbers					4216-11 4212-3	4219-13	4219-12	4215-5	4215-1	4215-4	4219-11	4213-3 4219-10	4173-9 4197-6	4213-4 4215-6	4211-2	4215 4213 4211	4219 4216 4215 4213 4212
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
SVOC 8270																	
2-Methylnaphthalene	0.200	0.460-1.00		<0.23<3.5	3.44 J	NA	NA	NA	NA	NA	NA	<0.460					
TOC				32,000-199,000	NA	NA	NA	NA	NA	NA	NA	19,500	NA	<5,000	NA	<5,000	NA

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.

TABLE 5-1. POL CATCHMENT ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Sediment
Site: POL Catchment (LF03) Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks		Lab Blanks	
					2SD09	2SD10			AB02	EB06		
Laboratory Sample ID Numbers					1678	1680			315 4303-1	1688/1690	#5-9693 #3&4-82493 #1&2-9493	#3&4-9693
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg			µg/L	µg/L	µg/L	mg/kg
DRPH	5-20	50-200	500[a]	9.55-1,150	<200J[b]	<50J[b]			NA	<1,000J[b]	<1,000J	NA
GRPH	0.2-0.8	2-8	100	<0.400-<9.0	<8J[b]	<2J[b]			<100J[b]	<50J[b]	<50J	<2J
RRPH (Approx.)	10-40	100-400	2,000[a]	<480	<400	<100			NA	<1,000	<2,000	NA
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.44	<0.10						
Benzene	0.002-0.008	0.02-0.08	0.5	<0.020-<0.300	<0.08	<0.02			<1	<1	<1	<0.02
Toluene	0.002-0.008	0.02-0.08		<0.020-<0.300	<0.08	<0.02			<1	<4J	<1	<0.02
Ethylbenzene	0.002-0.008	0.02-0.08		<0.020-<0.300	<0.08	<0.02			<1	<2J	<1	<0.02
Xylenes (Total)	0.004-0.02	0.04-0.2		<0.040-<0.600	<0.2	<0.04			<2	<5J	<2	<0.04

□ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE 5-1. POL CATCHMENT ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island   Matrix: Surface Water
Site: POL Catchment (LF03)   Units: $\mu g/L$

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blanks
					SW01	SW02	SW03		AB01	EB03	TB03	
Laboratory Sample ID Numbers					4216-6 4212-4	4219-8	4213-2 4219-9		4173-9 4197-6	4213-4 4215-6	4211-2	4219/4216 4215/4213 4212/4211
ANALYSES	$\mu g/L$	$\mu g/L$	$\mu g/L$	$\mu g/L$	$\mu g/L$	$\mu g/L$	$\mu g/L$		$\mu g/L$	$\mu g/L$	$\mu g/L$	$\mu g/L$
DRPH	100	100		<200	612[ad]	1,770[ad]	1,200[ad]		NA	<100	NA	<100
GRPH	20	20		<20	367[a]	<20	<20		NA	<20	NA	<20
BTEX (8020/8020 Mod.)												
Benzene	1	1	5	<1	2.7	<1	<1		<1	<1	<1[c]	<1
Toluene	1	1	1,000	<1	<1	<1	<1		1.2	3.2	<1[c]	<1
Ethylbenzene	1	1	700	<1	19	<1	<1		<1	<1	<1[c]	<1
Xylenes (Total)	1	1	10,000	<2	38.4	<2	<2		<2	<2	<2[c]	<2
VOC 8010												
1,2-Dichloroethane	1	1	5	1.3B-2.8B	4.6B	NA	NA		1.2	NA	NA	<1
VOC 8260												
Benzene	1	1	5	<1	2.5	NA	<1		<1	<1	<1	<1
n-Butylbenzene	1	1		<1	2.4	NA	<1		<1	<1	<1	<1
sec-Butylbenzene	1	1		<1	1.0	NA	<1		<1	<1	<1	<1
1,2-Dichloroethane	1	1	5	3U-3.2B	3.9B	NA	4.4B		1.6	2.2	<1	<1
Ethylbenzene	1	1	700	<1	18	NA	<1		<1	<1	<1	<1

☐ CT&E Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
U Compound is not present above the concentration listed.
a Total petroleum hydrocarbons in these water samples exceed the 15 $\mu g/L$ stated for fresh water in ADEC's Water Quality Criteria 18 AAC 70 (ADEC 1989).
c BTEX determined by 8260 method analysis.
d The laboratory reported that the EPH pattern in this sample was not consistent with an unweathered middle distillate fuel.

TABLE 5-1. POL CATCHMENT ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: POL Catchment (LF03)
Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blanks
					SW01	SW02	SW03		AB01	EB03	TB03	
Laboratory Sample ID Numbers					4216-6 4212-4	4219-8	4213-2 4219-9		4173-9 4197-6	4213-4 4215-6	4211-2	4219/4216 4215/4213 4212/4211
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L		µg/L	µg/L	µg/L	µg/L
Isopropylbenzene	1	1		<1	2.9	NA	<1		<1	<1	<1	<1
p-Isopropyltoluene	1	1		<1	2.1	NA	<1		<1	<1	<1	<1
Naphthalene	1	1		<1	35	NA	<1		<1	<1	<1	<1
n-Propylbenzene	1	1		<1	3.6	NA	<1		<1	<1	<1	<1
1,2,4-Trimethylbenzene	1	1		<1	19	NA	<1		<1	<1	<1	<1
1,3,5-Trimethylbenzene	1	1		<1	13	NA	<1		<1	<1	<1	<1
Xylenes (Total)	2	2	10,000	<2	33.3	NA	<2		<2	<2	<2	<2
SVOC 8270	10	10-11		<10	<10.6-<11	NA	<10		NA	<10	NA	<10
TOC	5,000	5,000		<5,000-12,700	48,100	NA	21,000		NA	<5,000	NA	<5,000
TSS	100	100		<30,000-8,000	71,000	NA	12,000		NA	NA	NA	<100-<200
TDS	10,000	10,000		<352,000-328,000	847,000	NA	637,000		NA	NA	NA	<10,000

☐ CT&E Data.
NA Not analyzed.

TABLE 5-2. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE POL CATCHMENT (LF03)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a] CANCER	RBSL[a] NON-CANCER	ARAR[b]	CHEMICAL OF CONCERN
POL Catchment (LF03)	Soil	DRPH	28,600	mg/kg	9.55-1,150	--	--	500[c]	YES
		GRPH	78.5	mg/kg	<0.400-<9	--	--	100[c]	NO
		RRPH	180	mg/kg	<480	--	--	2,000[c]	NO
		n-Butylbenzene	3.70	mg/kg	<0.025-<0.500	--	--	--	NO
		sec-Butylbenzene	1.62	mg/kg	<0.025-<0.500	--	--	--	NO
		Ethylbenzene	0.982	mg/kg	<0.020-<0.500	--	2,700	--	NO
		Isopropylbenzene	0.409	mg/kg	<0.025-<0.500	--	--	--	NO
		p-Isopropyltoluene	1.69	mg/kg	<0.025-<0.500	--	--	--	NO
		Methylene Chloride	0.225	mg/kg	<.020-<0.500	8.53	1,620	--	NO
		2-Methylnaphthalene	3.44	mg/kg	<0.230-<3.50	--	--	--	NO
		n-Propylbenzene	0.920	mg/kg	<0.025-<0.500	--	--	--	NO
		Tetrachloroethene	5.42	mg/kg	<0.020-<0.500	1.23	270	--	YES
		Toluene	0.116	mg/kg	<0.020-<0.500	--	5,400	--	NO
		1,2,4-Trimethylbenzene	0.638	mg/kg	<0.025-<0.500	--	--	--	NO
		1,3,5-Trimethylbenzene	0.536	mg/kg	<0.025-<0.500	--	--	--	NO
		Xylenes	5.30	mg/kg	<0.040-<1.000	--	54,000	--	NO
	Water	DRPH	1770	µg/L	<200	--	292	--	YES
		GRPH	367	µg/L	<20	50	730	--	YES
		Benzene	2.7	µg/L	<1	0.617	--	5[d]	YES

a Risk-Based Screening Level.
b Applicable or Relevant and Appropriate Requirement.
c ADEC 1991.
d MCL, 52 FR 25690.
e MCL, 56 FR 3526 (30 January 1991).

TABLE 5-2. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE POL CATCHMENT (LF03) (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a]		ARAR[b]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
POL Catchment	Water	n-Butylbenzene	2.4	µg/L	<1	--	--	--	NO
(LF03)	(Continued)	sec-Butylbenzene	1.0	µg/L	<1	--	--	--	NO
(Continued)		Ethylbenzene	19	µg/L	<1	--	158	700[e]	NO
		Isopropylbenzene	2.9	µg/L	<1	--	--	--	NO
		p-Isopropyltoluene	2.1	µg/L	<1	--	--	--	NO
		Naphthalene	35	µg/L	<1	--	--	--	NO
		n-Propylbenzene	3.6	µg/L	<1	--	--	--	NO
		1,2,4-Trimethylbenzene	19	µg/L	<1	--	--	--	NO
		1,3,5-Trimethylbenzene	13	µg/L	<1	--	--	--	NO
		Xylenes	38.4	µg/L	<2	--	7,300	10,000[e]	NO

a Risk-Based Screening Level.
b Applicable or Relevant and Appropriate Requirement.
c ADEC 1991.
d MCL, 52 FR 25690.
e MCL, 56 FR 3526 (30 January 1991).

5.2 HEATED STORAGE (SS13)

5.2.1 Site Background

The Heated Storage (SS13) site is located southeast of the module trains and the power house. The Heated Storage site is an approximately 80 feet by 40 feet building used for vehicle maintenance and storage. The building is raised approximately three to four feet above the tundra and is bounded by a gravel pad on the north, south, and east sides. The floor drains within the building discharged directly to the tundra areas below and may have received waste oils and other waste automotive fluids. The floor drains were sealed in July 1993 by the Air Force to prevent future release of contaminants from the Heated Storage site to the tundra.

The site-specific environmental setting describing the topography, surface water drainage, and soil types is presented in the discussion of potential migration pathways, Section 5.2.3.

5.2.2 Field Sampling and Analytical Results

This section describes the RI sampling and analytical results for samples collected at the Heated Storage site. The discussion presents a review of laboratory data, data summary tables, contaminants identified, contaminant trends, and information on suspected source areas.

5.2.2.1 Summary of Samples Collected. A total of 18 samples was collected during the RI from gravel pads, tundra, ponds, and streams at the site. These consisted of seven soil, six sediment, and five surface water samples. Table 2-2 presents a detailed summary of the samples collected and the analyses performed during the 1993 RI field activities. Locations of all samples collected at the Heated Storage (SS13) site and a summary of analytical results above background levels are presented in Figures 5-2 and 5-3.

Seven soil samples were analyzed for DRPH, GRPH, and BTEX. In addition, four samples were analyzed for HVOCs, VOCs, and PCBs. Three samples were analyzed for RRPH, and one sample was analyzed for SVOCs and total metals.

Six sediment samples were analyzed for DRPH, GRPH, and BTEX. In addition, five samples were analyzed for HVOCs. Three samples were analyzed for PCBs, and one sample was analyzed for VOCs, SVOCs, pesticides, and total metals.

Five surface water samples were analyzed for DRPH, GRPH, and BTEX. In addition, three samples were analyzed for HVOCs. Two samples were analyzed for VOCs, SVOCs, and total and dissolved metals.

5.2.2.2 Analytical Results. The data summary table (Table 5-2) presents analytical results for all samples collected at the site. Detection and quantitation limits, action levels, associated laboratory and field blanks, and background analytical results are presented for each of the analyses. Background levels are listed to allow direct comparison of naturally occurring organic compounds and inorganic analytes with samples collected from the site. Sample locations and analytical results for the samples at the site are illustrated in Figures 5-2 and 5-3.

All organic compounds detected are presented on the figures except when they were a result of laboratory contamination or decontamination procedures. The exceptions are presented on the data summary table. Only metals detected above background levels are presented on Figure 1-3. The following section presents a discussion of organic compounds and inorganic analytes detected above background levels at the site.

Organics. Organic compounds detected in soil and sediment samples at the site include DRPH, GRPH, RRPH, BTEX, one other VOC, and PCBs. DRPH were detected in 11 samples ranging from 32.5 to 3,580 mg/kg. GRPH were detected in eight samples ranging from 0.653 to 423 mg/kg. RRPH were detected in soil sample SS13-2S05-1 at 2,400 mg/kg. BTEX compounds were detected in eight soil/sediment samples. Total BTEX ranged from 0.021 to 3.445 mg/kg; xylenes were the predominant component. One other VOC, 1,3,5-trimethylbenzene, was detected at 7.68 mg/kg in soil sample SS13-S02. PCBs (Aroclor 1254) were detected in five samples ranging from 0.112 to 2.72 mg/kg.

In surface water samples, organic compounds detected include DRPH, GRPH, BTEX, and six other VOCs. DRPH were detected in all five surface water samples ranging from 196 to 5,760 μg/L. GRPH were detected in one sample, SS13-SW02, at 6.9 μg/L. BTEX compounds were detected in three surface water samples ranging from 3.1 to 12.8 μg/L (SS13-SW02, SS13-SW06, and SS13-SW07); benzene was detected in one sample at 6.9 μg/L. Six other VOCs were detected in surface water sample SS13-SW02 ranging from 1.3 to 12 μg/L; the primary VOC was tetrachloroethane (12 μg/L).

In addition, one VOC was detected in surface water samples and at similar concentrations in the field blank and background samples. This compound, 1,2-dichloroethane was detected at concentrations ranging from 3.3 to 9.1 μg/L in the environmental samples, 1.2 to 2.9 μg/L in the field blanks, and 1.3 to 3.2 μg/L in the background samples. These detections are assumed to be the result of field decontamination procedures. The hexane and methanol used in the decontamination procedures may have contained impurities including 1,2-dichloroethane.

Inorganics. Metals analyses indicated that two metals (lead and zinc) were detected at concentrations above background levels in soil/sediment samples at the site. Lead was detected at 33 mg/kg, and zinc was detected at 180 and 500 mg/kg in samples SS13-S02 and SS13-SD01, respectively.

In surface water samples, metals analyses detected four metals (calcium, iron, manganese, and potassium) above background concentrations.

5.2.2.3 Summary of Site Contamination. The primary contaminants at the site are DRPH, GRPH, and BTEX. The source of contaminants detected during sampling conducted at the Heated Storage (SS13) site is suspected to be the stained soil area below the building floor drains. These floor drains were sealed in July 1993 by the Air Force to prevent future release of chemicals from the Heated Storage to the environment. No previous sampling has been conducted at the site. The human health and ecological risks associated with the chemicals detected at the site are presented in Sections 5.2.4 and 5.2.5.

Contaminants exceeding action levels were detected in soil samples at the Heated Storage (SS13) site. Based on field data, source of contamination and concentration of the contaminants, significantly contaminated soil is limited to the area below the structure. Some of the contaminants have been carried by surface runoff to the east and west side of the Heated Storage site. The areas affected by migration of contaminants include gravel and tundra.

5.2.3 Migration Pathways

This section describes the topography and stratigraphy of the site and the migration potential of contaminants from the site. A discussion of receptors and chemical concentrations at receptors is included.

5.2.3.1 Topography and Stratigraphy. Topography at the site consists of a gravel pad and road placed upon relatively flat tundra (Figures 5-2 and 5-3). A non-incised stream meanders from the western portion of the site, around the southern end, and up the eastern side. The site is surrounded on the west, south, and east sides by marshy tundra. Several culverts drain the gravel pad and areas under buildings. These culverts drain to the tundra stream on the eastern side of the site.

During the 1993 RI, permafrost was located at a depth of approximately four feet under the gravel pads and at a depth of two and half feet under tundra areas. Gravel pads consisted of the typical gravels and sands associated with these features, and subsurface tundra materials were of the typical stratigraphy found at Barter Island (Section 2.4.4.2).

5.2.3.2 Migration Potential.

Subsurface Migration. Site topography indicates that active layer water flow should be towards the tundra stream, which encircles the west, south, and east sides of the site. Although seasonal flow may occur within the site, the surrounding stream should prevent the spread of affected active layer water away from the site because active layer water should discharge into the stream rather than flow past it. Contaminated active layer water that enters the stream no longer presents a potential for subsurface migration, but a potential for surface migration is then created. Contaminated soil/sediment and surface water downgradient of the Heated Storage may be the result of surface runoff during the spring thaw.

Surface Migration. The principal vehicle for surface migration at the site is the stream that encircles the west, south, and east sides. The stream is an active migration pathway. It was sampled as part of the investigation for the Garage (which also contributes to it) and found to be contaminated with DRPH, BTEX, and other VOCs. The Heated Storage site may contribute to contamination in this stream via surface drainage of affected water and from culverts that drain the area under this building. Surface soil and sediment samples from the mouth of the culvert that drains the Heated Storage site suggest that this culvert has been a migration pathway for contaminants.

Air Transport. Air transportation is not considered to be a significant mode of migration at the site (Section 2.4.4.5).

Summary of Migration Potential. Soil samples indicate that the potential for contaminated active layer water exists at the site. The topography suggests that any contaminated active layer water will be contained by the stream that encircles most of the site. The potential for offsite migration of contaminated active layer water appears low. The stream and culverts that drain the site are surface migration pathways. The Heated Storage site is believed to have contributed to contamination in tundra areas around the site. Another source, the Garage site, is also believed to have affected these areas.

5.2.3.3 Receptors and Chemical Concentrations at Receptors.

Human Receptors. Potential human receptors at the Heated Storage site include Air Force contractor personnel working at the station, visitors to the station, and an occasional local visitor passing the site to get to recreational or subsistence lands. Human receptors could potentially be exposed to the chemicals detected in surface water and soil/sediments at the site. The primary routes of potential exposures at the site are direct contact with soil/sediment, incidental ingestion of soil/sediment, and ingestion of surface water. Because groundwater and air at the Barter Island sites are not considered complete pathways of exposure, these media are not evaluated as potential pathways to human receptors.

The Barter Island Risk Assessment (U.S. Air Force 1996) evaluates in detail the risks to human health from all COCs detected at the site. The potential receptor groups were selected based on their likelihood of exposure to contaminants at the site and include DEW Line workers at the installation, and native adults and children who may visit the site. The estimated exposure point concentrations for human receptors are based on the maximum concentration of each chemical detected at the site. The potential risks to human health associated with site chemicals at Barter Island are presented in Section 5.2.4.

Ecological Receptors. Ecological receptors were evaluated in detail in the Barter Island Risk Assessment (U.S. Air Force 1996) to determine if plants and animals could potentially be impacted by the chemicals detected at the Barter Island installation. Because of the diversity of the plants and animals in the area of the Barter Island installation, a set of representative species was selected in the ERA for detailed evaluation. The species include plants, aquatic invertebrates, fish, birds, and mammals. These receptors were selected based on the species' likelihood of exposure given their preferred habitat and feeding habits. The representative species encompass a range of ecological niches in order to achieve the best characterization of the ecosystems being examined and are presented in Table 2-6.

The estimate of chemical concentrations at the ecological receptors was based on the average site-wide concentration of each COC. This approach was appropriate because few of the representative species would inhabit only one distinct site at the installation; they are more likely to be exposed to the mix of chemicals and concentrations detected on all the sites at Barter Island. The potential ecological risks associated with the chemicals detected at the site are presented in Section 5.2.5.

5.2.4 Human Health Risk Assessment

This section presents a summary of the potential human health risks associated with the chemicals detected at the Heated Storage site (SS13). The purpose of the human health risk assessment is to quantify the excess lifetime cancer risk and/or the noncancer hazard (reported as hazard index) from the contaminants detected at the site.

This summary presents the COCs at the site, the pathways by which human receptors may be exposed to site chemicals, potential risks to human health posed by each chemical through each exposure pathway, the significance of the risk and/or hazard estimate, and a comparison of site chemical concentrations to ARARs. The methods and assumptions used in calculating hazards and risks are presented in Section 2.4.1.

5.2.4.1 Chemicals of Concern. At the Heated Storage site (SS13), COCs identified for the soil/sediment matrix included DRPH, GRPH, RRPH, and the PCB, Aroclor 1254. The maximum concentrations of DRPH, GRPH, and RRPH exceeded the ARARs for petroleum hydrocarbon contamination of soil (ADEC 1991a). The maximum concentration of Aroclor 1254 exceeded the noncarcinogen RBSL.

DRPH, benzene, tetrachloroethane, and manganese were identified as COCs in surface water at the site. The maximum concentration of DRPH exceeded the noncarcinogen RBSL for diesel contamination of surface water. The maximum concentrations of benzene and tetrachloroethane exceeded their carcinogen RBSLs. The maximum concentration of manganese exceeded the noncarcinogen RBSL. 1,2-Dichloroethane was detected at this site; however, 1,2-dichloroethane was detected in the associated blank and background samples at similar concentrations. Therefore, it was not included as a COC.

Table 5-4, Identification of COCs at the Heated Storage, presents the maximum concentrations of chemicals detected at the site and the associated background concentrations, RBSLs, and ARARs, and identifies COCs selected for the risk evaluation.

5.2.4.2 Exposure Pathways and Potential Receptors. Because COCs were identified for soil/sediment and surface water, ingestion of soil/sediment and surface water were evaluated in the risk assessment at this site.

Three potential receptor groups were evaluated in the risk assessment: an adult assigned to a DEW Line installation (worker), an adult inhabitant of communities in the North Slope of Alaska (native), and a child living in a North Slope community (child).

5.2.4.3 Risk Characterization.

Noncancer Hazard and Cancer Risk Associated with Soils and Sediments. The noncancer hazard associated with the ingestion of soil at the Heated Storage (SS13) by a hypothetical native northern adult/child is 0.258, and by a DEW Line worker is 0.012, based on the maximum concentrations of the COCs. The presence of DRPH, GRPH, RRPH, and Aroclor 1254 accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations. The

excess lifetime cancer risk associated with the ingestion of soil at the site by a hypothetical native northern adult/child is 4×10^{-6}, and by a DEW Line worker is 2×10^{-7}, based on the maximum concentrations of the COCs. The presence of PCBs accounts for more than 95 percent of the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

Noncancer Hazard and Cancer Risk Associated with Surface Water. The noncancer hazard associated with the ingestion of surface water at the Heated Storage site by a hypothetical native northern adult or a DEW Line worker is 2.55, based on the maximum concentrations of the COCs. The presence of DRPH and manganese accounts for more than 99 percent of the quantifiable noncancer hazard for these receptor/pathway combinations.

The excess lifetime cancer risk associated with the ingestion of surface water at the site by a hypothetical native northern adult is 1×10^{-5}, and by a DEW Line worker is 2×10^{-6}, based on the maximum concentrations of the COCs. The presence of benzene and tetrachloroethane accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

5.2.4.4 Summary of Human Health Risk Assessment. The potential risks and hazards associated with the soil/sediment at the Heated Storage site are the low noncancer hazard (hazard indices of 0.012 and 0.258), and low cancer risks associated with the GRPH and the PCB, Aroclor 1254. The noncancer hazards are below one and were calculated conservatively based on a residential scenario. The risks and hazards were estimated based on ingestion of soil at a rate associated with a residential scenario. It is very unlikely that the soil at this location would be ingested at the conservative rate used in the risk calculation, and the hazards and risks at the site are likely to be overestimated. Remedial action is generally not warranted at sites where the excess lifetime cancer risk is less than 1×10^{-4} and the noncancer hazards are below one (EPA 1991c), and on the basis of the cancer risk and noncancer hazard for soil/sediment, remediation of the site is not necessarily warranted.

The potential risks and hazards associated with the surface water at the Heated Storage site are the hazard index of 2.55 and cancer risks (2×10^{-6} and 1×10^{-5}) for both the adult worker and native. The noncancer hazard is associated with the levels of DRPH, tetrachloroethane, and manganese detected in surface water. The cancer risks (2×10^{-6} and 1×10^{-5}) are associated with benzene and tetrachloroethane detected in surface water at the site. The noncancer hazards and cancer risks in surface water were calculated assuming the affected surface water would be used as a sole-source water supply for 180 days per year. Based on site-specific information, the above mentioned chemicals detected in surface water do not currently pose a health hazard nor are they likely to pose a hazard in the future. The surface water expressions at the site are frozen most of the year; many are only intermittently filled with water during the summer months. The surface water at the site is not known to be used as a water supply now, nor has it been used in the past.

In conclusion, under current uses the COCs identified in soil/sediment and surface water at the Heated Storage site pose only a minimal, if any, potential threat to human health. Based on the human health risk assessment, remedial actions are not warranted at the site. In the unlikely

event that surface water at the site is used as a sole-source drinking water supply in the future, a potential noncancer hazard to human health could exist if current conditions remain constant.

5.2.5 Ecological Risk Assessment

The objective of the ERA is to estimate the potential impacts of chemicals detected at the installation to aquatic and terrestrial plants and animals. A summary of the methods used to assess potential ecological impacts is presented in Section 2.4.2.

5.2.5.1 Chemicals of Concern. COCs were selected based on criteria presented in Section 3.1 of the ERA. The average installation-wide concentrations of COCs were used to calculate the risk estimates. DRPH, aluminum, iron, and manganese were the COCs detected in surface water at the Heated Storage site, and the COCs detected in soils/sediments were DRPH, ethylbenzene, xylenes, PCBs (Aroclor 1254), lead, and zinc. DRPH and iron were the surface water COCs associated with elevated HQs, and zinc in soil/sediment was associated with an elevated HQ at the Heated Storage site. PCBs were associated with future risks at the Heated Storage site.

5.2.5.2 Exposure Pathways and Potential Receptors. Potential exposure pathways for terrestrial and aquatic organisms include direct contact with, and ingestion of, contaminated soil/sediment and/or surface water. The most significant route of exposure for plants is direct contact with soil. Aquatic organisms such as fish and invertebrates are primarily exposed through direct contact with surface water, and average surface water concentrations were used to evaluate potential exposures. They may also be exposed to COCs through ingestion of plant and animal items in their diet, and incidental ingestion of soil/sediment while foraging, although these pathways are considered less significant and are not used to calculate HQs. Birds and mammals may be exposed to COCs through ingestion of surface water, ingestion of plant and animal diet items (although only ingestion of plant matter was quantified in the estimated exposure equation), and incidental ingestion of soil/sediment.

The potential ecological receptors evaluated in the risk assessment include plants, aquatic organisms, birds, and mammals likely to occur along the Arctic Coastal Plain. Representative species from these receptor groups were selected based primarily on the species' likelihood of exposure, preferred habitat, and feeding habits. Species that may be particularly sensitive to environmental impacts, such as threatened and endangered species, are considered on an individual basis if present at or near the installation. Spectacled and Steller's eiders have been identified in the vicinity of the Barter Island installation, although there is a low probability that either species is currently nesting or raising broods on the Barter Island sites (Alaska Biological Research 1994). The ERA evaluation included the spectacled eider, and this evaluation was also used to evaluate any potential risk to Steller's eiders should they be found at the installation. The species evaluated in the ERA are listed in Table 2-6.

5.2.5.3 Risk Characterization. Potential ecological risk at the Heated Storage site was associated with the elevated surface water HQs for DRPH and iron. The DRPH HQ for *Daphnia* spp. was three, and the iron HQs for the arctic char, nine-spined stickleback, and *Daphnia* spp.

were nine. The zinc HQ for the Lapland longspur was one, and although future risk was not quantified, risk is possible from exposure to PCBs because of the potential for bioaccumulation.

5.2.5.4 Summary of Ecological Risk Assessment. Although the HQs are elevated for iron in surface water, iron's essential nutrient status, the uncertainty associated with the TRVs for this metal, and the relatively low HQs indicate that the calculated potential risk from iron in surface water is subject to mitigating factors. The HQs were developed using the total concentration of iron in surface water. Adverse impacts to aquatic receptors would be likely to result from dissolved iron concentrations, which are within the range of background concentrations for iron at the Heated Storage site. Thus, risk from iron in surface water is not expected to be significant.

The elevated HQ for *Daphnia* spp. indicates that there may be risk associated with DRPH in surface water at this site, although the magnitude of the HQ (three) is evidence that the risk is low and may affect just the organisms present at the "hot spot" locations, rather than the entire *Daphnia* population. As a result the potential risk to *Daphnia* spp. at the Heated Storage site is not likely to be significant.

The risk associated with the elevated zinc HQ for the Lapland longspur is mitigated by the zinc's essential nutrient status, the low magnitude of the HQ (one), and the low likelihood of repeated exposure at the hot spots responsible for the elevated average of zinc concentrations.

Although the risk estimates do not indicate risks associated with the concentrations of PCBs currently detected, there is a future risk potential at the Heated Storage site because PCBs are known to bioaccumulate. Refer to Section 3.4.5, Potential Future Risks, in the Barter Island ERA (U.S. Air Force 1996) for a more thorough discussion of potential future risks associated with PCBs.

5.2.6 Conclusions and Recommendations

Sampling and analyses have determined that the Heated Storage (SS13) site is contaminated with petroleum hydrocarbons (DRPH and GRPH), BTEX compounds, and low levels of solvents and PCBs. Some metals (inorganics) detected at the site at slightly elevated levels were also considered to be COCs. The contaminated areas at the site are soil/sediment and surface water. The soil/sediment areas beneath the site building have the highest concentrations of contaminants. The likely source of contamination is discharge of waste materials to floor drains in the building. The floor drains were sealed in 1993 and current waste management practices should prevent future releases of contaminants at the site.

Migration of contaminants from the site appears to have occurred via a stream and culverts that lead from beneath the Heated Storage site to tundra areas. From the tundra area contaminants have migrated via a drainage pathway to the north. Contaminants detected in soil/sediment and surface water samples from these downgradient areas were similar to those detected below the Heated Storage site; however, downgradient concentrations were lower.

The risk assessment concluded that risks posed to human health and ecological receptors by site contaminants are minimal given current site uses. Under a future scenario, using the surface water in the drainage pathways from the site as a drinking water supply results in a potential risk to human health. This human health risk, however, is not of a magnitude that normally requires remedial action. The ERA concluded that the overall potential risks presented by site contaminants are low. Therefore, under current site conditions considering and the findings of the risk assessment, remediation of the site is not necessarily warranted.

Levels of petroleum compounds (primarily diesel and gasoline) detected in soil/sediment at the site significantly exceed ADEC guidance cleanup levels. In addition, contaminants have migrated downgradient of the site and have impacted soil/sediment and surface water. Therefore, the site is being recommended for remedial action. The contaminated areas at the site include 110 cubic yards of soil beneath the building, 50 cubic yards of gravel, and 232 cubic yards of tundra. The remedial action alternative recommended for beneath the building is in situ biosurfactants, for gravel areas, and for tundra, passive bioremediation is the recommended alternative. A complete description and evaluation of the remedial alternatives recommended for this site are presented in the Feasibility Study, Section 6.0.

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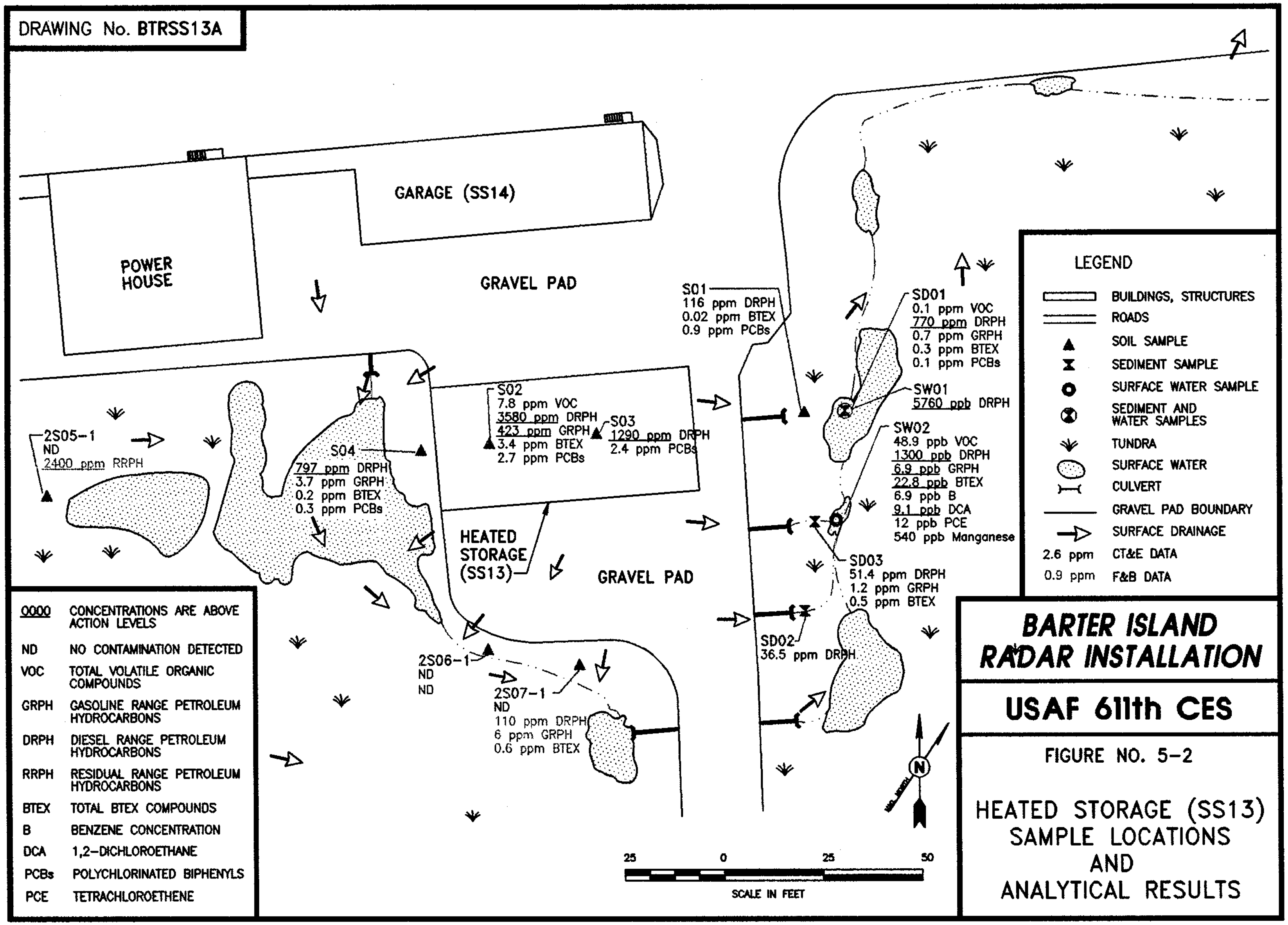

BARTER ISLAND RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 5-2

HEATED STORAGE (SS13) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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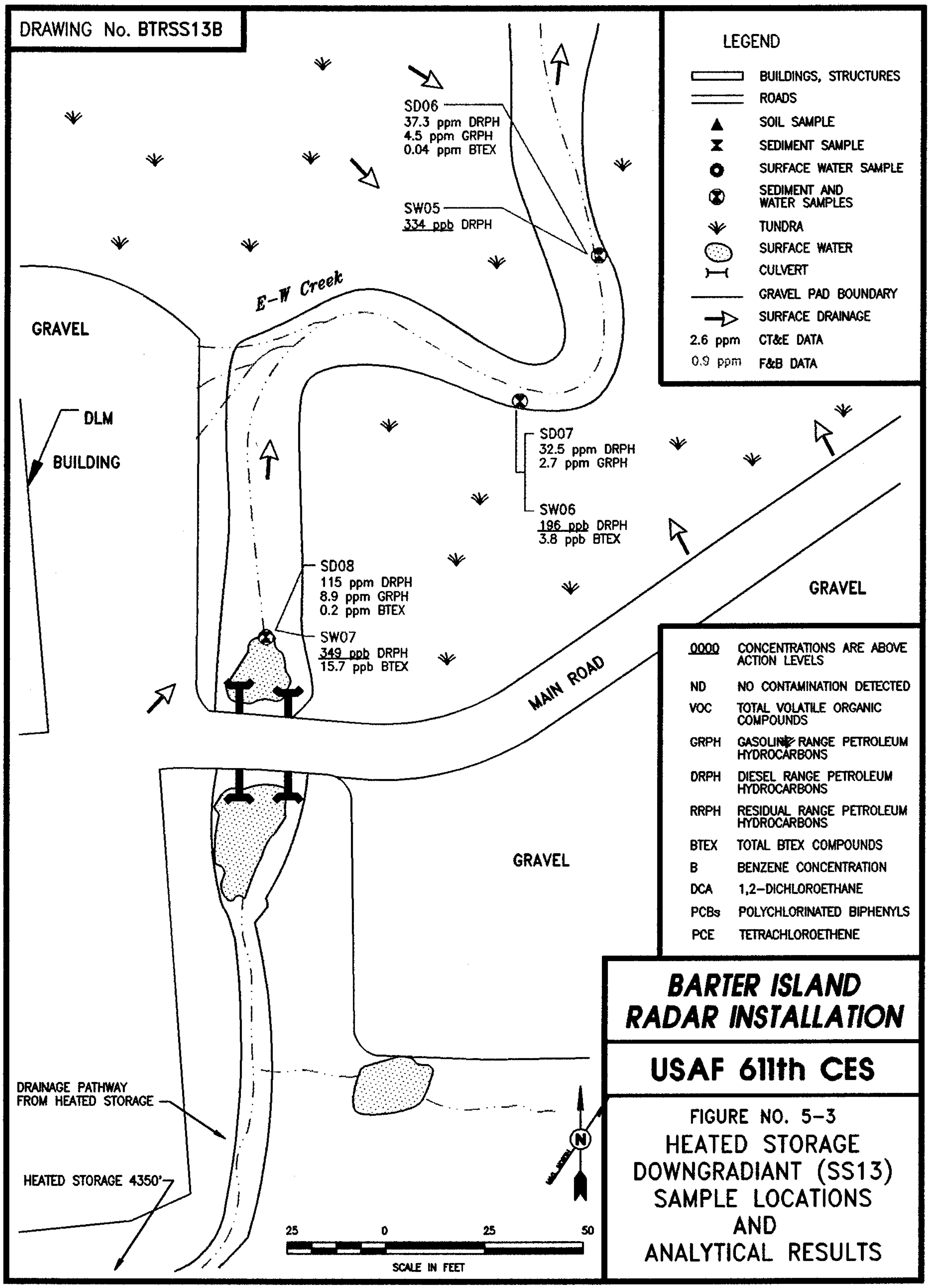

DRAWING No. BTRSS13B
LEGEND
BUILDINGS, STRUCTURES
ROADS
SOIL SAMPLE
SEDIMENT SAMPLE
SURFACE WATER SAMPLE
SEDIMENT AND WATER SAMPLES
TUNDRA
SURFACE WATER
CULVERT
GRAVEL PAD BOUNDARY
SURFACE DRAINAGE
2.6 ppm CT&E DATA
0.9 ppm F&B DATA
SD06
37.3 ppm DRPH
4.5 ppm GRPH
0.04 ppm BTEX
SW05
334 ppb DRPH
E-W Creek
GRAVEL
DLM
BUILDING
SD07
32.5 ppm DRPH
2.7 ppm GRPH
SW06
196 ppb DRPH
3.8 ppb BTEX
GRAVEL
SD08
115 ppm DRPH
8.9 ppm GRPH
0.2 ppm BTEX
SW07
349 ppb DRPH
15.7 ppb BTEX
MAIN ROAD
0000 CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND NO CONTAMINATION DETECTED
VOC TOTAL VOLATILE ORGANIC COMPOUNDS
GRPH GASOLINE RANGE PETROLEUM HYDROCARBONS
DRPH DIESEL RANGE PETROLEUM HYDROCARBONS
RRPH RESIDUAL RANGE PETROLEUM HYDROCARBONS
BTEX TOTAL BTEX COMPOUNDS
B BENZENE CONCENTRATION
DCA 1,2-DICHLOROETHANE
PCBs POLYCHLORINATED BIPHENYLS
PCE TETRACHLOROETHENE
GRAVEL
DRAINAGE PATHWAY FROM HEATED STORAGE
HEATED STORAGE 4350'
N
25 0 25 50
SCALE IN FEET
BARTER ISLAND RADAR INSTALLATION
USAF 611th CES
FIGURE NO. 5-3
HEATED STORAGE DOWNGRADIANT (SS13) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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TABLE 5-3. HEATED STORAGE ANALYTICAL DATA SUMMARY

Installation: Barter Island
Site: Heated Storage (Building 87) (SS13)
Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blank	
					S01	S02	S03	S04	AB01	EB03A	TB03		
Laboratory Sample ID Numbers					4216-3	4212-5 4216-10	4219-5	4219-6	4173-9 4197-8	4211-1 4215-7	4211-2	4197/4173 4215/4211	4219/4216 4212
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	9.55-1,150	116[f]	3,580J[g]	1,290[d]	797[e]	NA	<100	NA	<100	<4.00
GRPH	0.400	0.400	100	<0.400-<9.0	<0.400	423	<0.400	3.65	NA	<20	NA	<20	<0.400
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	0.021	3.445N	<0.100	0.22					
Benzene	0.020	0.020	0.5	<0.020-<0.300	<0.020	<0.020	<0.020	<0.020	<1	<1	<1[c]	<1	<0.020
Toluene	0.020	0.020		<0.020-<0.300	<0.020	0.632N	<0.020	0.03	1.2	<1	<1[c]	<1	<0.020
Ethylbenzene	0.020	0.020		<0.020-<0.300	<0.020	0.283N	<0.020	0.03	<1	<1	<1[c]	<1	<0.020
Xylenes (Total)	0.040	0.040		<0.040-<0.600	0.021	2.53N	<0.040	0.16	<2	<2	<2[c]	<2	<0.040
VOC 8010	0.020	0.020		<0.020-<0.300	<0.020	<0.020	<0.020	<0.020	<1-9.8	NA	NA	<1	<0.020
VOC 8260													
1,3,5-Trimethylbenzene	0.020	0.020		<0.025-<0.500	NA	7.68	NA	NA	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.040		<0.050-<1.000	NA	0.124	NA	NA	<2	<2	<2	<2	<0.040
SVOC 8270	0.200	2.10		<0.230-<3.50	NA	<2.10	NA	NA	NA	<11	<1	<10	<0.200
PCBs													
Aroclor 1254	0.020	0.020	10	<0.020-<0.100	0.932	2.72	2.4	0.316	NA	<1	NA	<1	<0.010

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.
N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification".
a The action level for DRPH is based on conversations with ADEC; a final action level has not yet been determined.
c BTEX determined by 8260 method analysis.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.
e The laboratory reported that 310 mg/kg of the EPH pattern in this sample was not consistent with a middle distillate fuel.
f The laboratory reported that the EPH pattern in this sample was not consistent with an unweathered middle distillate fuel.
g The laboratory reported that 1090 mg/kg of the EPH pattern in this sample was not consistent with an unweathered middle distillate fuel.

TABLE 5-3. HEATED STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Soil
Site: Heated Storage (Building 87) (SS13) Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples 2S05-1	Environmental Samples 2S06-1	Environmental Samples 2S07-1	Field Blanks AB03	Field Blanks EB07	Lab Blanks	Lab Blanks
Laboratory Sample ID Numbers					1724 4616-10	1726 4616-12	1728 4616-11	1712	1715 1716 4616-9	#3&4-82493 #1&2-9693 #5-9693 4616	#1&2-9693 #6-9593 4616
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00-60	500[a]	9.55-1,150	<60[b]	<4.00[c]	110J[b]	NA	<200[d]	<200	<50
GRPH	0.400	0.400-1	100	<0.4-<9	<1J[b]	<0.400[c]	6J[b]	<50J[b]	<20[d]	<20-<50J	<0.400-<1J
RRPH (Approx.)	12	120	2,000[a]	<480	2,400	<120	<120	NA	<1,000	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.10	<0.10	0.57J				
Benzene	0.002	0.02	0.5	<0.020-<0.300	<0.02	<0.02	<0.02	<1	<1	<1	<0.02
Toluene	0.002	0.02		<0.020-<0.300	<0.02	<0.02	<0.02	<3J	<2J	<1	<0.02
Ethylbenzene	0.002	0.02		<0.020-<0.300	<0.02	<0.02	0.07	<2J	<1	<1	<0.02
Xylenes (Total)	0.004	0.04		<0.040-<0.600	<0.04	<0.04	0.5J	<5J	<2	<2	<0.04
VOC 8260	0.020	0.020-0.070		<0.025-<0.500	<0.070	<0.020	<0.020	NA	<1-8.3	<1	<0.020

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c This sample was analyzed by F&B also; DRPH and GRPH were detected at <60[b] and <1J[b] mg/kg, respectively.
d This sample was analyzed by F&B also; DRPH and GRPH were detected at <1,000J[b] and <50[b] µg/L, respectively.

TABLE 5-3. HEATED STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island — Matrix: Sediment
Site: Heated Storage (Building 87) (SS13) — Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks			Lab Blanks	
					SD01	SD02	SD03	AB01	EB03A	TB03		
Laboratory Sample ID Numbers					4212-2 4216-5	4219-1	4219-4	4173-9 4197-6	4211-1 4215-7	4211-2	4197 4173 4215 4211	4219 4216 4212
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	9.55-1,150	770J[f]	36.5[d]	51.4[e]	NA	<100	NA	<100	<4.00
GRPH	0.400	0.400	100	<0.400-<9.0	0.653	<0.400	1.17	NA	<20	NA	<20	<0.400
BTEX (8020/8020 Mod.)			15 Total BTEX	<0.250-<1.500	0.321N	<0.100	0.48					
Benzene	0.020	0.020-0.025	0.5	<0.020-<0.300	<0.025	<0.020	<0.020	<1	<1	<1[c]	<1	<0.020
Toluene	0.020	0.020-0.025		<0.020-<0.300	<0.025	<0.020	0.23	1.2	<1	<1[c]	<1	<0.020
Ethylbenzene	0.020	0.020-0.025		<0.020-<0.300	0.028N	<0.020	<0.020	<1	<1	<1[c]	<1	<0.020
Xylenes (Total)	0.040	0.040-0.050		<0.040-<0.600	0.293N	<0.040	0.25	<2	<2	<2[c]	<2	<0.040
VOC 8010	0.020	0.020		<0.020-<0.300	NA	<0.020	<0.020	<1-9.8	NA	NA	<1	<0.020
VOC 8260												
Toluene	0.020	0.020		<0.025-<0.500	0.029	NA	NA	1.9	3.3	<1	<1	<0.020
Xylenes (Total)	0.040	0.040		<0.050-<1.000	0.052	NA	NA	<2	<2	<2	<2	<0.040

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.
N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification".
a The action level for DRPH is based on conversations with ADEC; a final action level has not yet been determined.
c BTEX determined by 8260 method analysis.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.
e The laboratory reported that 40.2 mg/kg of the EPH pattern in this sample was not consistent with a middle distillate fuel.
f The laboratory reported that the EPH pattern in this sample was not consistent with an unweathered middle distillate fuel.

TABLE 5-3. HEATED STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Heated Storage (Building 87) (SS13)
Matrix: Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks			Lab Blanks	
					SD01	SD02	SD03	AB01	EB03A	TB03		
Laboratory Sample ID Numbers					4212-2 4216-5	4219-1	4219-4	4173-9 4197-6	4211-1 4215-7	4211-2	4215 4211	4216 4212
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
SVOC 8270	0.200	1.00		<0.23-<3.5	<1.00	NA	NA	NA	<11	NA	<10	<0.200
PCBs												
Aroclor 1254	0.020	0.02-0.1	10	<0.020-<0.100	0.112	<0.1	<0.02	NA	<1	NA	<10	<0.020

☐ CT&E Data.
NA Not analyzed.

TABLE 5-3. HEATED STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Sediment
Site: Heated Storage (Building 87) (SS13) Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks			Lab Blanks	
					SD06	SD07	SD08	AB01	EB01	TB02		
Laboratory Sample ID Numbers					4203-2	4203-3	4203-1	4173-9 4197-6	4203-8 4175-3	4179-5 4199-13	4203	4203
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	9.55-1,150	37.3	32.5	115	NA	<200	NA	<200	<4.00
GRPH	0.400	0.400	100	<0.400-<9.0	4.45	2.7	8.94	NA	<20	NA	<20	<0.400
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	0.043	<0.125	0.224					
Benzene	0.020	0.020-0.025	0.5	<0.020-<0.300	<0.020	<0.025	<0.020	<1	<1	<1	<1	<0.020
Toluene	0.020	0.020-0.025		<0.020-<0.300	<0.020	<0.025	<0.020	1.2	<1	<1	<1	<0.020
Ethylbenzene	0.020	0.020-0.025		<0.020-<0.300	<0.020	<0.025	0.045	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.040-0.050		<0.040-<0.600	0.043	<0.050	0.179	<2	<2	<2	<2	<0.040
VOC 8010	0.020	0.020-0.025		<0.020-<0.300	<0.020	<0.025	<0.020	<1-9.8	<1-2.5	<1	<1	<0.020
Pesticides (8080)	0.001	0.020		<0.001-<0.100	NA	NA	<0.02	NA	<1J	NA	<0.1-<1	<0.001

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.
a The action level for DRPH is based on conversations with ADEC; a final action level has not yet been determined.

TABLE 5-3. HEATED STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Heated Storage (Building 87) (SS13)
Matrix: Soil/Sediment
Units: mg/kg
METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples						Field Blank			Lab Blanks
					S02	SD01						EB03A		
Laboratory Sample ID Numbers					4212-5	4212-2						4211-1		4212 4211
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg						µg/L		µg/L
Aluminum	0.35	2		1,500-25,000	3,000	2,900						<100		<100
Antimony	N/A	53-54		<7.8-<230	<54	<53						<100		<100
Arsenic	0.11	5.3-5.4		<4.9-8.5	<5.4	<5.3						<100		<100
Barium	0.024	1		27-390	43	23						<50		<50
Beryllium	N/A	2.7		<2.6-6.4	<2.7	<2.7						<50		<50
Cadmium	0.33	1-2.7		<3.0-<36	<2.7	2.7						<50		<50
Calcium	0.69	4		360-59,000	14,000	5,100						<200		<200
Chromium	0.066	1		<4.3-47	17	11						<50		<50
Cobalt	N/A	5.3-5.4		<5.1-12	<5.4	<5.3						<100		<100
Copper	0.045	1		<2.7-45	12	7.5						<50		<50
Iron	0.50	2		5,400-35,000	9,600	8,000						<100		<100
Lead	0.13	2		<5.1-22	33	33						<100		<100
Magnesium	0.96	4		360-7,400	4,900	2,400						<200		<200
Manganese	0.025	1		25-290	96	56						<50		<50
Molybdenum	N/A	2.7		<2.5-<11	<2.7	<2.7						<50		<50
Nickel	0.11	1		4.2-46	7.9	6.6						<50		<50
Potassium	23	100		<300-2,200	580	360						<5,000		<5,000
Selenium	1.2	53-54		<7.8-<170	<54	<53						<100		<100

☐ CT&E Data.
N/A Not available.

TABLE 5-3. HEATED STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Heated Storage (Building 87) (SS13)

Matrix: Soil/Sediment
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples						Field Blank			Lab Blanks
					S02	SD01						EB03A		
Laboratory Sample ID Numbers					4212-5	4212-2						4211-1		4212 4211
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg						µg/L		µg/L
Silver	0.53	2.7		<3-<110	<2.7	<2.7						<50		<50
Sodium	0.55	5		<160-680	60	38						<250		<250
Thallium	0.011	<0.27		<0.2-<1.2	<0.27	<0.27						<5		<5
Vanadium	0.036	1		6.3-59	9.1	14						<50		<50
Zinc	0.16	1		9.2-95	180	500						<50		<50

☐ CT&E Data.

TABLE 5-3. HEATED STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island   Matrix: Surface Water
Site: Heated Storage (Building 87) (SS13)   Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blanks
					SW01	SW02			AB01	EB03A	TB03	
Laboratory Sample ID Numbers					4212-1 4216-4	4213-1 4219-7			4173-9 4197-6	4211-1 4215-7	4211-2	4219 4216/4213 4212/4211 4197/4173
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L			µg/L	µg/L	µg/L	µg/L
DRPH	100	100		<200	5,760[a]	1,300[ad]			NA	<100	NA	<100
GRPH	20	20		<20	<20	6.9[a]			NA	<20	NA	<20
BTEX (8020/8020 Mod.)												
Benzene	1	1	5	<1	<1	6.9			<1	<1	<1[c]	<1
Toluene	1	1	1,000	<1	<1	<1			1.2	<1	<1[c]	<1
Ethylbenzene	1	1	700	<1	<1	3.1			<1	<1	<1[c]	<1
Xylenes (Total)	2	2	10,000	<2	<2	12.8			<2	<2	<2[c]	<2
VOC 8260												
Benzene	1	1	5	<1	<1	6.4			<1	<1	<1	<1
Chloromethane	1	1		<1	<1	4.2			<1	<1	<1	<1
1,2-Dichloroethane	1	1	5	3U-3.2B	6.1B	9.1B			1.6	<1	<1	<1
Ethylbenzene	1	1	700	<1	<1	2.5			<1	<1	<1	<1
Naphthalene	1	1		<1	<1	1.6			<1	<1	<1	<1

☐ CT&E Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
U Compound is not present above the concentration listed.
a Total petroleum hydrocarbons in these water samples exceed the 15 µg/L stated for fresh water in ADEC's Water Quality Criteria 18 AAC 70 (ADEC 1989).
c BTEX determined by 8260 method analysis.
d The laboratory reported that the EPH pattern in this sample was not consistent with an unweathered middle distillate fuel.

TABLE 5-3. HEATED STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Heated Storage (Building 87) (SS13)
Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blanks
					SW01	SW02			AB01	EB03A	TB03	
Laboratory Sample ID Numbers					4212-1 4216-4	4213-1 4219-7			4173-9 4197-6	4211-1 4215-7	4211-2	4215 4212/4211 4197/4173
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L			µg/L	µg/L	µg/L	µg/L
Tetrachloroethene	1	1	5	<1	<1	12			<1	<1	<1	<1
1,2,4-Trimethylbenzene	1	1		<1	<1	1.4			<1	<1	<1	<1
1,3,5-Trimethylbenzene	1	1		<1	<1	1.3			<1	<1	<1	<1
Xylenes (Total)	2	2	10,000	<2	<2	10.4			<2	<2	<2	<2
SVOC	10	10		<10	<10	<10			NA	<11	NA	<10

☐ CT&E Data.
NA Not analyzed.

TABLE 5-3. HEATED STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island — Matrix: Surface Water
Site: Heated Storage (Building 87) (SS13) — Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks
					SW05	SW06	SW07			AB01	EB02	TB02	
Laboratory Sample ID Numbers					4206-2	4206-3	4206-1			4197-6	4206-4	4199-13	4206 4199 4197
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L			µg/L	µg/L	µg/L	µg/L
DRPH	100	100		<200	334[a]	196[a]	349[a]			NA	<100	NA	<100
GRPH	20	20		<20	<20	<20	<20			NA	<20	NA	<20
BTEX (8020/8020 Mod.)													
Benzene	1	1	5	<1	<1	<1	<1			<1	<1	<1	<1
Toluene	1	1	1,000	<1	<1	<1	<1			1.2	<1	<1	<1
Ethylbenzene	1	1	700	<1	<1	<1	3.2			<1	<1	<1	<1
Xylenes (Total)	2	2	10,000	<2	<2	3.8	12.5			<2	<2	<2	<2
VOC 8010													
1,2-Dichloroethane	1	1	5	3U-3.2B	3.3B	3.8B	<1			1.2	2.9	<1	<1

☐ CT&E Data.
N/A Not analyzed.
B The analyte was detected in the associated blank.
U Compound is not present above the concentration listed.
a Total hydrocarbons in these water samples exceed the 15 µg/L stated for fresh water in ADEC's Water Quality Criteria 18 AAC 70 (ADEC 1989).

TABLE 5-3. HEATED STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Heated Storage (Building 87) (SS13)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples							Field Blank			Lab Blanks
					SW01	SW02							EB03A		
Laboratory Sample ID Numbers					4212-1	4213-1							4211-1		4213 4212 4211
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L							µg/L		µg/L
Aluminum	17.4	100		<100-350 (<100-340)	160 (<100)	210 (<100)							<100 (<100)		<100 (<100)
Antimony	N/A	100	6	<100 (<100)	<100 (<100)	<100 (<100)							<100 (<100)		<100 (<100)
Arsenic	5.3	100	50	<100 (<100)	<100 (<100)	<100 (<100)							<100 (<100)		<100 (<100)
Barium	1.2	50	2,000	<50-93 (<50-91)	82 (68)	82 (65)							<50 (<50)		<50 (<50)
Beryllium	N/A	50	4	<50 (<50)	<50 (<50)	<50 (<50)							<50 (<50)		<50 (<50)
Cadmium	1.7	50	5	<50 (<50)	<50 (<50)	<50 (<50)							<50 (<50)		<50 (<50)
Calcium	34.5	200		4,500-88,000 (4,100-86,000)	75,000 (71,000)	130,000 (130,000)							<200 (<200)		<200 (<200)
Chromium	3.29	100	100	<50 (<50)	<50 (<50)	<50 (<50)							<50 (<50)		<50 (<50)
Cobalt	N/A	100		<100 (<100)	<100 (<100)	<100 (<100)							<100 (<100)		<100 (<100)
Copper	2.3	50	1,300	<50 (<50)	<50 (<50)	<50 (<50)							<50 (<50)		<50 (<50)

☐ CT&E Data.
N/A Not available.

TABLE 5-3. HEATED STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Heated Storage (Building 87) (SS13)
Matrix: Surface Water
Units: µg/L
METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples							Field Blank			Lab Blanks
					SW01	SW02							EB03A		
Laboratory Sample ID Numbers					4212-1	4213-1							4211-1		4213 4212 4211
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L							µg/L		µg/L
Iron	25	100		180-2,800 (<100-1,600)	1,600 (280)	12,000 (4,000)							<100 (<100)		<100-792 (792)
Lead	6.6	100	15	<100 (<100)	<100 (<100)	<100 (<100)							<100 (<100)		<100 (<100)
Magnesium	47.8	200		<5,000-53,000 (2,600-54,000)	26,000 (25,000)	46,000 (46,000)							<200 (<200)		<200 (<200)
Manganese	1.24	50		<50-510 (<50-120)	310 (240)	540 (500)							<50 (<50)		<50 (<50)
Molybdenum	N/A	50		<50 (<50)	<50 (<50)	<50 (<50)							<50 (<50)		<50 (<50)
Nickel	5.5	50	100	<50 (<50)	<50 (<50)	<50 (<50)							<50 (<50)		<50-82 (82)
Potassium	1,154	5,000		<5,000 (<5,000)	5,100 (<5,000)	17,000 (17,000)							<5,000 (<5,000)		<5,000 (<5,000)
Selenium	62.4	100	50	<100 (<100)	<100 (<100)	<100 (<100)							<100 (<100)		<100 (<100)
Silver	2.6	50	50	<50 (<50)	<50 (<50)	<50 (<50)							<50 (<50)		<50 (<50)
Sodium	27.7	250		8,400-410,000 (8,200-450,000)	100,000 (110,000)	92,000 (98,000)							<250 (<250)		<250 (<250)
Thallium	0.57	5	2	<5 (<5)	<5 (<5)	<5 (<5)							<5 (<5)		<5 (<5)

☐ CT&E Data.
N/A Not available.

TABLE 5-3. HEATED STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Heated Storage (Building 87) (SS13)

Matrix: Surface Water
Units: $\mu g/L$

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples							Field Blank			Lab Blanks
					SW01	SW02							EB03A		
Laboratory Sample ID Numbers					4212-1	4213-1							4211-1		4213 4212 4211
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L							µg/L		µg/L
Vanadium	1.8	50		<50 (<50)	<50 (<50)	<50 (<50)							<50 (<50)		<50 (<50)
Zinc	8.2	50		<50-160 (<50)	<50 (<50)	<50 (<50)							<50 (<50)		<50 (<50)

☐ CT&E Data.

TABLE 5-4. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE HEATED STORAGE (SS13)

SITE	MATRIX	CHEMICAL DETECTED[a]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[b]		ARAR[c]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Heated Storage (SS13)	Soil	DRPH	3,580	mg/kg	9.55-1,150	--	--	500[d]	YES
		GRPH	423	mg/kg	<0.400-<9	--	--	100[d]	YES
		RRPH	2,400	mg/kg	<480	--	--	2,000[d]	YES
		Ethylbenzene	0.283	mg/kg	<0.020-<0.500	--	2,700	--	NO
		Toluene	0.632	mg/kg	<0.020-<0.500	--	5,400	--	NO
		1,3,5-Trimethylbenzene	7.68	mg/kg	<0.025-<0.500	--	--	--	NO
		Xylenes	2.53	mg/kg	<0.040-<1.000	--	54,000	--	NO
		Aroclor 1254	2.72	mg/kg	<0.020-<0.100	--	0.54	10[e]	YES
		Aluminum	3,000	mg/kg	1,500-25,000	--	--	--	NO
		Barium	43	mg/kg	27-390	--	1,890	--	NO
		Cadmium	2.7	mg/kg	<3.0-<36	--	27	--	NO
		Calcium	14,000	mg/kg	360-59,000	--	--	--	NO
		Chromium	17	mg/kg	<4.3-47	--	135	--	NO
		Copper	12	mg/kg	<2.7-45	--	999	--	NO
		Iron	9,600	mg/kg	5,400-35,000	--	--	--	NO
		Lead	33	mg/kg	<5.1-22	--	--	500[f]	NO

a The concentrations reported for metals in surface water are total metals.
b Risk-Based Screening Level.
c Applicable or Relevant and Appropriate Requirement.
d ADEC 1991.
e TSCA Cleanup Level.
f EPA 1989d.
g MCL, 52 FR 25690 (08 July 1987).
h MCL, 56 FR 3526 (30 January 1991).
i MCL, 56 FR 30266 (01 July 1991).
j 1,2-Dichloroethane was detected in the majority of blank and background samples and was, therefore, not included as a COC.

TABLE 5-4. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE HEATED STORAGE (SS13) (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED[a]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[b]		ARAR[c]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Heated Storage (SS13) (Continued)	Soil	Magnesium	4,900	mg/kg	360-7,400	--	--	--	NO
		Manganese	96	mg/kg	25-290	--	3,780	--	NO
		Nickel	7.9	mg/kg	4.2-46	--	540	--	NO
		Potassium	580	mg/kg	<300-2,200	--	--	--	NO
		Sodium	60	mg/kg	<160-680	--	--	--	NO
		Vanadium	14	mg/kg	6.03-59	--	189	--	NO
		Zinc	500	mg/kg	9.2-95	--	8,100	--	NO
	Water	DRPH	5,760	µg/L	<200	--	292	--	**YES**
		GRPH	6.9	µg/L	<20	50	730	--	NO
		Benzene	6.9	µg/L	<1	0.617	--	5[g]	**YES**
		Chloromethane	4.2	µg/L	<1	6.54	--	--	NO
		1,2-Dichloroethane	9.1	µg/L	1.3B-3.2B	0.934	--	5[g]	NO[j]
		Ethylbenzene	3.2	µg/L	<1	--	158	700[h]	NO
		Naphthalene	1.6	µg/L	<1	--	--	--	NO
		Tetrachloroethene	12	µg/L	<1	1.63	36.5	5[h]	**YES**
		1,2,4-Trimethylbenzene	1.4	µg/L	<1	--	--	--	NO

a The concentrations reported for metals in surface water are total metals.
b Risk-Based Screening Level.
c Applicable or Relevant and Appropriate Requirement.
d ADEC 1991.
e TSCA Cleanup Level.
f EPA 1989d.
g MCL, 52 FR 25690 (08 July 1987).
h MCL, 56 FR 3526 (30 January 1991).
i MCL, 56 FR 30266 (01 July 1991).
j 1,2-Dichloroethane was detected in the majority of blank and background samples and was, therefore, not included as a COC.

TABLE 5-4. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE HEATED STORAGE (SS13) (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED[a]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[b] CANCER	RBSL[b] NON-CANCER	ARAR[c]	CHEMICAL OF CONCERN
Heated Storage	Water	1,3,5-Trimethylbenzene	1.3	µg/L	<1	--	--	--	NO
(SS13)	(Continued)	Xylenes	12.8	µg/L	<2	--	7,300	10,000[h]	NO
(Continued)		Aluminum	210	µg/L	<100-350	--	--	--	NO
		Barium	82	µg/L	<50-93	--	256	2,000[i]	NO
		Calcium	130,000	µg/L	4,100-88,000	--	--	--	NO
		Iron	12,000	µg/L	<100-2,800	--	--	--	NO
		Magnesium	46,000	µg/L	<5,000-54,000	--	--	--	NO
		Manganese	540	µg/L	<50-510	--	18.3	--	**YES**
		Potassium	17,000	µg/L	<5,000	--	--	--	NO
		Sodium	110,000	µg/L	8,200-450,000	--	--	--	NO

a The concentrations reported for metals in surface water are total metals.
b Risk-Based Screening Level.
c Applicable or Relevant and Appropriate Requirement.
d ADEC 1991.
e TSCA Cleanup Level.
f EPA 1989d.
g MCL, 52 FR 25690 (08 July 1987).
h MCL, 56 FR 3526 (30 January 1991).
i MCL, 56 FR 30266 (01 July 1991).
j 1,2-Dichloroethane was detected in the majority of blank and background samples and was, therefore, not included as a COC.

5.3 GARAGE (SS14)

5.3.1 Site Background

The Garage (SS14) site is located east of the powerhouse and north of the Heated Storage site. The Garage is an approximately 90 feet by 30 feet building that is elevated approximately three feet above the tundra and surrounded by a gravel pad. The building is used for vehicle maintenance and storage and is connected to the module train by a corridor. The floor drains in this building discharged directly to the tundra beneath the structure and may have received vehicle maintenance waste. The drains were sealed in July 1993 by the Air Force to prevent future release of contaminants.

The site-specific environmental setting describing the topography, surface water drainage, and soil types is presented in the discussion of potential migration pathways, Section 5.3.3.

5.3.2 Field Sampling and Analytical Results

This section describes the RI sampling and analytical results for samples collected at the Garage site. The discussion presents a review of laboratory data, data summary tables, contaminants identified, contaminant trends, and information on suspected source areas.

5.3.2.1 Summary of Samples Collected. A total of nine samples was collected at the site. These consisted of seven soil samples, one sediment sample, and one surface water sample. Table 2-2 presents a detailed summary of the samples collected and the analyses performed during the 1993 RI field activities. Locations of all samples collected at the Garage (SS14) site and a summary of analytical results above background levels are presented in Figure 5-4.

Seven soil samples were analyzed for DRPH, GRPH, and RRPH. In addition, four samples were analyzed for PCBs. Four samples were analyzed for BTEX and VOCs, and one sample was analyzed for HVOCs, SVOCs, total metals, and pesticides.

One sediment sample was analyzed for DRPH, GRPH, RRPH, BTEX, HVOCs, VOCs, SVOCs, and total metals.

One surface water sample was analyzed for DRPH, GRPH, RRPH, BTEX, HVOCs, SVOCs, pesticides, and total and dissolved metals.

5.3.2.2 Analytical Results. The data summary table (Table 5-3) presents analytical results for all samples collected at the site. Detection and quantitation limits, action levels, associated laboratory and field blanks, and background analytical results are presented for each of the analyses. Background levels are listed to allow a direct comparison of naturally occurring organic compounds and inorganic analytes with samples collected from the site. Sample locations and analytical results for the samples at the site are illustrated in Figure 5-4. All organic compounds detected are presented on the figure except when they were a result of laboratory

contamination or field decontamination procedures. The exceptions are presented on the data summary table. Only metals above background levels are presented on Figure 3-1.

The following section presents a discussion of organic compounds and inorganic analytes detected above background levels at the site.

Organics. Organic compounds detected in soil and sediment samples collected at the site include DRPH, GRPH, RRPH, BTEX compounds, eleven other VOCs, and SVOCs. DRPH were detected in five samples ranging from 3,100 to 12,400 mg/kg. GRPH were detected in the same five samples ranging from 118 to 700 mg/kg. RRPH were detected in four samples ranging from 410 to 27,000 mg/kg. BTEX compounds were detected in four samples. Total BTEX ranged from 0.206 to 59 mg/kg. Xylenes were the primary components, but benzene was detected in one sample at 1.4 mg/kg. Eleven other VOCs were detected in five soil/sediment samples collected at the site. The primary VOCs detected were naphthalene (46 mg/kg), 1,2,4-trimethylbenzene (14.7 mg/kg), and 1,3,5-trimethylbenzene (9.32 mg/kg); all are common components of diesel fuel. The eight other VOCs ranged from 0.023 to 4.22 mg/kg. In addition, five SVOCs were detected in two soil/sediment samples ranging from 1.49 to 14.5 mg/kg (samples SS14-S04-2 and SS14-SD01).

In surface water samples, xylenes were the only organic compound detected (8 µg/L in SS14-SW01).

Inorganics. Metals analyses detected three metals (chromium, lead, and zinc) in soil above background levels. Chromium, lead, and zinc were detected at 53, 231, and 200 mg/kg, respectively in sediment sample SS14-SD01.

In surface water sample SS14-SW01, metals analyses detected four metals (calcium, iron, manganese, and potassium) above background levels (105,000; 6,000; 490; and 9,100 mg/kg, respectively).

5.3.2.3 Summary of Site Contamination. The source of contaminants detected during sampling conducted at the Garage is suspected to be waste discharged to the Garage floor drains. Limited access prevented sampling directly below the Garage; however, the area is stained and assumed to be contaminated. The predominant site contaminants are DRPH, GRPH, and RRPH. No previous sampling had been conducted at the site. The human health and ecological risks associated with the chemicals detected at the site are presented in Sections 5.3.4 and 5.3.5.

Based on field data, source of contamination, and concentration of the contaminants, the area of significantly contaminated soil includes the area below the structure, approximately 500 square feet of gravel pad east of the structure, and an area of similar size below the culvert on the east side of the Garage. It is suspected that some of the contaminants have been carried by surface runoff through culverts to the east and south of the Garage. The tundra areas downgradient of the Garage are addressed with the Heated Storage (SS13) site.

5.3.3 Migration Pathways

This section describes the topography and stratigraphy of the site and the migration potential of contaminants from the site. A discussion of receptors and chemical concentrations at receptors is included.

5.3.3.1 Topography and Stratigraphy. Topography at the site consists of gravel pads placed upon relatively flat tundra (Figure 5-4). A small non-incised stream meanders from the south edge of the gravel pad to the east side. Southwest and east of the site is marshy tundra, and south of the site is the Heated Storage (SS13) site. The gravel pad surrounding the Garage is approximately four feet high. The gravel pad near the southwest corner of the Garage is sloped slightly inward, creating a depression. A culvert opening south of the Garage may drain the gravel pad in this area, but this could not be confirmed by the field investigators. Another culvert drains the area under the Garage eastward, into the tundra and stream.

During the 1993 RI, permafrost was located at a depth of approximately four feet under the gravel pad and road and at a depth of two and a half feet under tundra areas. Gravel pads consisted of the typical gravels and sands associated with these features (Section 2.4.4.2).

5.3.3.2 Migration Potential.

Subsurface Migration. Subsurface flow may be a migration pathway at the site. The presence of petroleum compounds at depth indicates that these compounds may have impacted active layer water quality, and surface soils that have been contaminated may represent a continued threat to infiltrating water. The greatest potential for the migration of contaminated active layer water is near the southwest corner of the site, where runoff is funneled to a depression. Analytical data indicate that there is significant subsurface DRPH contamination of soils here, and this area is believed to be drained by a culvert to tundra area to the south. Sediment samples near the mouth of this culvert indicate that significant DRPH contamination has occurred. Topographic information indicates that elsewhere near the site the direction of active layer water flow should be towards the east. Although seasonal flow may occur within the site, the stream to the east should intercept the migration of contaminated active layer water, because water will discharge into this stream rather than flow past it. Contaminated active layer water that enters the stream no longer presents a potential for subsurface migration, but a potential for surface migration is created.

Surface Migration. Sampling and analyses indicate that surface migration occurred at the site. Water samples from the stream (which may have been affected by both the Garage and the Heated Storage sites) indicate the presence of DRPH, BTEX, and other VOCs. The entry points for contamination into the stream are the southern culvert (which drains a DRPH contaminated area of the gravel pad) and the eastern culvert (where laboratory analyses indicated DRPH and BTEX contamination).

Air Transport. Air transportation is not considered to be a significant mode of migration at the site (Section 2.4.4.5).

Summary of Migration Potential. Culverts that drain the area beneath the Garage are migration pathways to the adjacent tundra areas. The stream adjacent to the site is the dominant surface migration pathway. Analytical data indicate that this stream and the pond areas next to it have become contaminated with petroleum compounds. This stream has probably served as a surface water migration pathway for contaminants entering the Contaminated Ditch (SD08). Soil samples suggest that active layer water at the site may be contaminated; however, active layer water probably cannot travel offsite because of the encircling stream.

5.3.3.3 Receptors and Chemical Concentrations at Receptors.

Human Receptors. Potential human receptors at the Garage site include Air Force contractor personnel working at the station, visitors to the station, and an occasional local visitor passing the site to get to recreational or subsistence lands. Human receptors could potentially be exposed to the chemicals detected in surface water and soil/sediments at the site. The primary routes of potential exposures at the site are direct contact with soil/sediment, incidental ingestion of soil/sediment, and ingestion of surface water. Because groundwater and air at the Barter Island sites are not considered complete pathways of exposure, these media are not evaluated as potential pathways to human receptors.

The Barter Island Risk Assessment (U.S. Air Force 1996) evaluates in detail the risks to human health from all COCs detected at the site. The potential receptor groups were selected based on their likelihood of exposure to contaminants at the site and include DEW Line workers at the installation, and native adults and children who may visit the site. The estimated exposure point concentrations for human receptors are based on the maximum concentration of each chemical detected at the site. The potential risks to human health associated with site chemicals at Barter Island are presented in Section 5.3.4.

Ecological Receptors. Ecological receptors were evaluated in detail in the Barter Island Risk Assessment (U.S. Air Force 1996) to determine if plants and animals could potentially be impacted by the chemicals detected at the Barter Island installation. Because of the diversity of the plants and animals in the area of the Barter Island installation, a set of representative species was selected in the ERA for detailed evaluation. The species include plants, aquatic invertebrates, fish, birds, and mammals. These receptors were selected based on the species' likelihood of exposure given their preferred habitat and feeding habits. The representative species encompass a range of ecological niches in order to achieve the best characterization the ecosystems being examined and are presented in Table 2-6.

The estimate of chemical concentrations at the ecological receptors was based on the average site-wide concentration of each COC. This approach was appropriate because few of the representative species would inhabit only one distinct site at the installation; they are more likely to be exposed to the mix of chemicals and concentrations detected on all the sites at Barter Island. The potential ecological risks associated with chemicals detected at the site are presented in Section 5.3.5.

5.3.4 Human Health Risk Assessment

This section presents a summary of the potential human health risks associated with the chemicals detected at the Garage (SS14) site. The purpose of the human health risk assessment is to quantify the excess lifetime cancer risk and/or the noncancer hazard (reported as hazard index) from the contaminants detected at the site.

This summary presents the COCs at the site, the pathways by which human receptors may be exposed to site chemicals, potential risks to human health posed by each chemical through each exposure pathway, the significance of the risk and/or hazard estimate, and a comparison of site chemical concentrations to ARARs. The methods and assumptions used in calculating hazards and risks are presented in Section 2.4.1.

5.3.4.1 Chemicals of Concern. At the Garage (SS14), COCs identified for the soil/sediment matrix included DRPH, GRPH, RRPH, benzene, and bis(2-ethylhexyl)phthalate. No COCs for the ERA were selected for surface water at the site. The DRPH, GRPH, and RRPH were selected because maximum concentration exceeded ARARS. The other COCs were selected because the maximum concentrations exceeded RBSLs.

Table 5-6, Identification of COCs at the Garage, presents the maximum concentrations of chemicals detected at the site and the associated background concentrations, RBSLs, and ARARs, and identifies COCs selected in the risk evaluation.

5.3.4.2 Exposure Pathways and Potential Receptors. Because no COCs were identified for surface water at the Garage site, only ingestion of soil/sediment was evaluated in the risk assessment. Surface water to the south and east of the site is evaluated as part of the Heated Storage site (SS13).

Three potential receptor groups were evaluated in the risk assessment: an adult assigned to a DEW Line installation (worker), an adult inhabitant of communities in the North Slope of Alaska (native), and a child living in a North Slope community (child).

5.3.4.3 Risk Characterization.

Noncancer Hazard and Cancer Risk Associated with Soils and Sediments. The noncancer hazard associated with the ingestion of soil at the Garage by a hypothetical native northern adult/child is 0.602 and by a DEW Line worker is 0.029, based on the maximum concentrations of the COCs. The presence of DRPH, GRPH, RRPH, and bis(2-ethylhexyl)phthalate accounts for the quantifiable noncancer hazard for these receptor/pathway combinations.

The excess lifetime cancer risk associated with the ingestion of soil at the site by a hypothetical native northern adult/child is 2×10^{-7}, and by a DEW Line worker is 1×10^{-8}, based on the maximum concentrations of the COCs. The presence of GRPH accounts for more than 90 percent of the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

Noncancer Hazard and Cancer Risk Associated with Surface Water. No COCs were identified for surface water at the site. The concentrations measured were below concentrations considered acceptable under Region 10 guidance (EPA 1991a) and ARARs.

Summary of Human Health Risk Assessment. The potential risks and hazards associated with the soil/sediment at the Garage are the very low noncancer hazard (hazard indices of 0.029 and 0.602), and very low cancer risk associated with the GRPH, benzene, and a phthalate compound. The noncancer hazards are below one and were calculated conservatively based on a residential scenario. Therefore, the noncancer hazards associated with soil/sediment at the site are minimal. The cancer risks are well below threshold value of 1×10^{-6} and are also considered minimal (EPA 1991c).

In conclusion, under current uses, the COCs identified in soil/sediment at the Garage site pose only a minimal, if any, potential threat to human health. Based on the human health risk assessment, remedial actions are not warranted at the site.

5.3.5 Ecological Risk Assessment

The objective of the ERA is to estimate the potential impacts of chemicals detected at the installation to aquatic and terrestrial plants and animals. A summary of the methods used to assess potential ecological impacts is presented in Section 2.4.2.

5.3.5.1 Chemicals of Concern. COCs were selected based on criteria presented in Section 3.1 of the ERA. The average installation-wide concentrations of COCs were used to calculate the risk estimates. Iron and manganese were the COCs detected in surface water at the Garage site, and the COCs detected in soil/sediment were DRPH, naphthalene, lead, and zinc. Iron in surface water and zinc in soil/sediment were the only COCs associated with elevated HQs at the Garage site.

5.3.5.2 Exposure Pathways and Potential Receptors. Potential exposure pathways for terrestrial and aquatic organisms include direct contact with, and ingestion of, contaminated soil/sediment and/or surface water. The most significant route of exposure for plants is direct contact with soil. Aquatic organisms such as fish and invertebrates are primarily exposed through direct contact with surface water, and average surface water concentrations were used to evaluate potential exposures. They may also be exposed to COCs through ingestion of plant and animal items in their diet, and incidental ingestion of soil/sediment while foraging, although these pathways are considered less significant and are not used to calculate HQs. Birds and mammals may be exposed to COCs through ingestion of surface water, ingestion of plant and animal diet items (although only ingestion of plant matter was quantified in the estimated exposure equation), and incidental ingestion of soil/sediment.

The potential ecological receptors evaluated in the risk assessment include plants, aquatic organisms, birds, and mammals likely to occur along the Arctic Coastal Plain. Representative species from these receptor groups were selected based primarily on the species' likelihood of exposure, preferred habitat, and feeding habits. Species that may be particularly sensitive to environmental impacts, such as threatened and endangered species, are considered on an

individual basis if they are present at or near the installation. Spectacled and Steller's eiders have been identified in the vicinity of the Barter Island installation, although there is a low probability that either species is currently nesting or raising broods on the Barter Island sites (Alaska Biological Research 1994). The ERA evaluation included the spectacled eider, and this evaluation was used to evaluate any potential risk to Steller's eiders should they be found at the installation. The species evaluated in the ERA are listed in Table 2-6.

5.3.5.3 Risk Characterization. Potential ecological risk at the Garage site was associated with the elevated surface water HQs for iron, which was nine for arctic char, nine-spined stickleback, and *Daphnia* spp. The zinc HQ in soil/sediment was one for the Lapland longspur.

5.3.5.4 Summary of Ecological Risk Assessment. Both the metals associated with the elevated HQs, iron and zinc, are essential nutrients. The concentrations of iron and zinc are based on one and two samples, respectively. It is unlikely that ecological receptors will be repeatedly exposed at these sample locations, so exposures will be lower than calculated in the ERA. The relatively low HQs and the above facts mitigate the risks posed by iron in surface water and zinc in soil/sediment at the Garage site. Risks to ecological receptors at the Garage site are not expected to be significant.

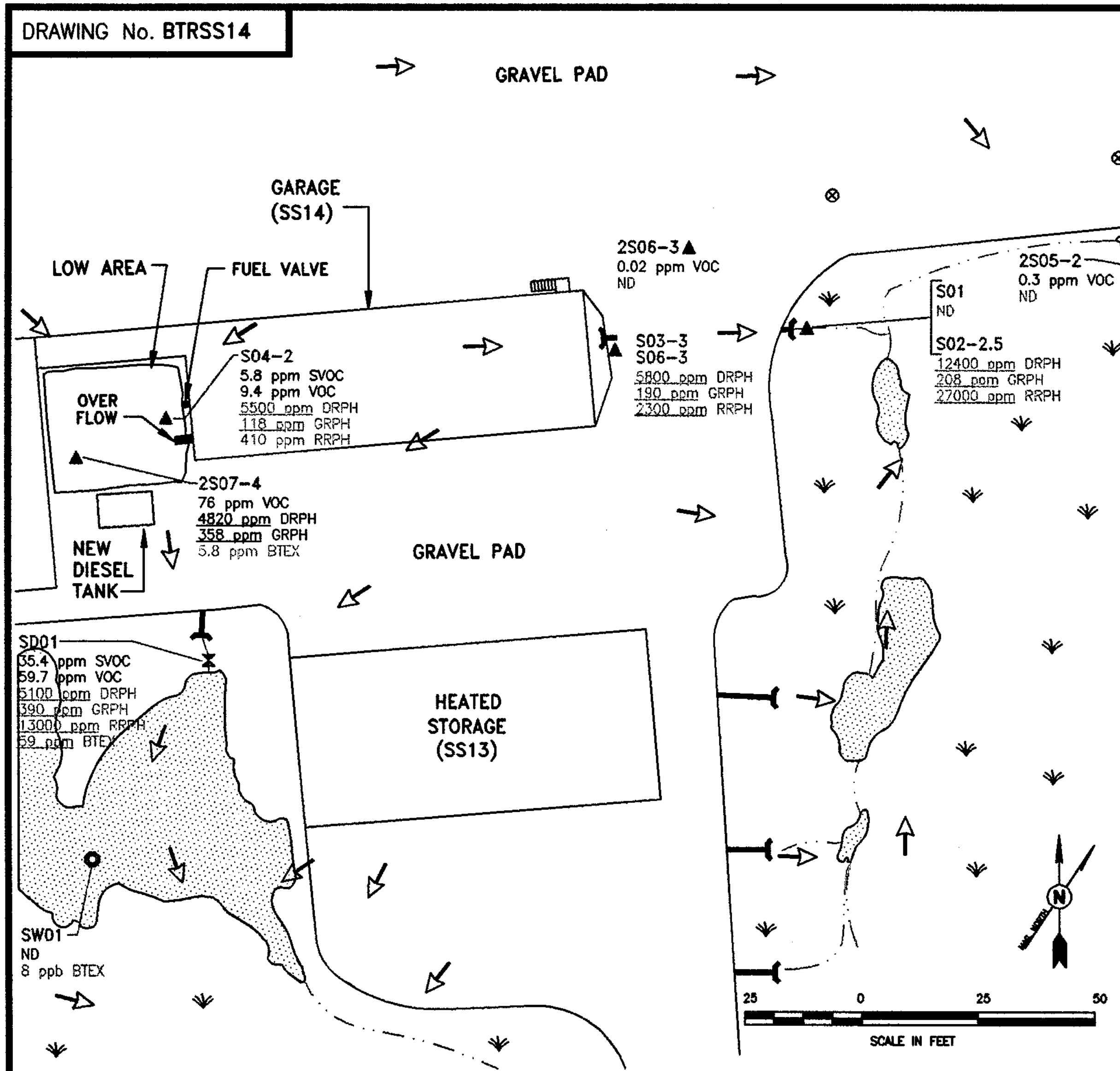
5.3.6 Conclusions and Recommendations

Sampling and analyses have determined that the Garage (SS14) site is contaminated with petroleum hydrocarbons (DRPH, GRPH, and RRPH), BTEX, VOCs, and SVOCs, most of which are components of diesel fuel. The contaminated areas at the site are the disturbed tundra beneath the Garage building and gravel areas to the east and west of the Garage. Although the area beneath the building could not be sampled because of limited access, visual observations and samples collected at the ends of the building indicate the area beneath the Garage is contaminated. The likely source of contamination is discharge of liquid waste materials to floor drains in the building. These floor drains were sealed in 1993, and current waste management practices should prevent future releases of contaminants at the site.

Migration of contaminants from the site appears to have occurred via culverts that lead from beneath the Garage building to gravel areas to the east and west. Contaminants detected in these gravel areas may have migrated to the same drainage pathways associated with the Heated Storage site. A discussion of these downgradient pathways and the contaminants detected is presented with the Heated Storage site, Section 5.2.

The risk assessment concluded that risks posed to human health and ecological receptors by site contaminants are minimal given current site uses. Based on the human health risk assessment, the potential human health risks at the site are not of a magnitude that normally requires remedial action. The ERA concluded that the overall potential risks presented by site contaminants are low. Therefore, under current site conditions and considering the findings of the risk assessment, remediation of the site is not necessarily warranted.

Levels of petroleum compounds (primarily diesel and gasoline) detected in soil/sediment at the site exceed ADEC guidance cleanup levels. In addition, site contaminants have migrated downgradient of the site, have impacted gravel areas, and are likely to have contributed to the contaminated tundra areas associated with the Heated Storage (SS13) site. Therefore, the site is being recommended for remedial action. The contaminated areas at the site include 110 cubic yards of soil beneath the building and 150 cubic yards of adjoining gravel. The remedial action alternative recommended for soil beneath the building is in situ biosurfactants. For gravel areas, the recommended remedial alternative is passive bioremediation. A complete description and evaluation of the remedial alternatives considered for this site are presented in the Feasibility Study, Section 6.0.



LEGEND

	BUILDINGS, STRUCTURES
	ROADS
▲	SOIL SAMPLE
⧗	SEDIMENT SAMPLE
O	SURFACE WATER SAMPLE
	TUNDRA
	SURFACE WATER
	CULVERT
	GRAVEL PAD BOUNDARY
→	SURFACE DRAINAGE
2.6 ppm	CT&E DATA
0.9 ppm	F&B DATA
⊗	UTILITY POST
0000	CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND	NO CONTAMINATION DETECTED
SVOC	TOTAL SEMI-VOLATILE ORGANIC COMPOUNDS
VOC	TOTAL VOLATILE ORGANIC COMPOUNDS
DRPH	DIESEL RANGE PETROLEUM HYDROCARBONS
GRPH	GASOLINE RANGE PETROLEUM HYDROCARBONS
RRPH	RESIDUAL RANGE PETROLEUM HYDROCARBONS
BTEX	TOTAL BTEX COMPOUNDS

BARTER ISLAND RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 5-4

GARAGE (SS14) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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TABLE 5-5. GARAGE ANALYTICAL DATA SUMMARY

Installation: Barter Island
Site: Garage (SS14)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks	
					S01	S02-2.5	S03-3 & S06-3 (Replicates)		S04-2	AB02	EB05	TB05		
Laboratory Sample ID Numbers					339	341	343	347	345 4301-7	315 4303-1	332 392 4303-5	375	#5-8249 #3&4-82493 #1&2-82493 4303	#6-82393 #1&2-82493 4301
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5	50	500[a]	9.55-1,150	<50J[b]	12,400J[b]	5,800J[b]	3,100J[b]	5,500J[b]	NA	<1,000[b]	NA	NA	<50J
GRPH	0.2	2	100	<0.400-<9.0	<2J[b]	208J[b]	190J[b]	190J[b]	118J[b]	<100J[b]	<100J[b]	<50J[b]	<50J-<100J	<2J
RRPH (Approx.)	10	100	2,000[a]	<480	<100	27,000	2,300	<100	410	NA	<1,000	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.10	25R	48.2R	0.24R	<0.10R					
Benzene	0.002	0.02	0.5	<0.020-<0.300	<0.02	0.4R	<0.02R	<0.02R	<0.02R	<1	<1	<1	<1	<0.02J
Toluene	0.002	0.02		<0.020-<0.300	<0.02	0.6R	<0.02R	0.06R	<0.02R	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002	0.02		<0.020-<0.300	<0.02	14R	8.2R	0.09R	<0.02R	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004	0.04		<0.040-<0.600	<0.04	10R	40R	0.09R	<0.04R	<2	<2	<2	<2	<0.04
HVOC (8010 Mod.)														
Tetrachloroethene	0.002-0.01	0.02-0.1		<0.5J	<0.02	0.06R	0.06R	<0.1R	<0.02R	<1	<1	<1	<1	<0.02J
VOC 8260														
Naphthalene	0.020	0.200		<0.025-<0.500	NA	NA	NA	NA	2.78	<1	<1	NA	<1	<0.020
1,3,5-Trimethyl-benzene	0.020	0.200		<0.025-<0.500	NA	NA	NA	NA	6.32	<1	<1	NA	<1	<0.020
Xylenes (Total)	0.040	0.400		<0.050-<1.000	NA	NA	NA	NA	0.293[c]	<2	<2	NA	<2	<0.040
SVOC 8270														
2-Methylnaphthalene	0.200	2.10		<0.23-<3.5	NA	NA	NA	NA	5.84	NA	<11	NA	<10	<0.200

□ CT&E Data.
▦ F&B Data.
NA Not analyzed.
J Result is an estimate.
R Result has been rejected.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c Result is indicative of o-xylenes only.

TABLE 5-5. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Garage (SS14)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks	
					S01	S02-2.5	S03-3 & S06-3 (Replicates)		S04-2	AB02	EB05	TB05		
Laboratory Sample ID Numbers					339	341	343	347	345 4301-7	315 4303-1	332 392 4303-5	375	#5-8249 #3&4-82493 #1&2-82493 4303	#6-82393 #1&2-82493 4301
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
Pesticides	0.002	0.02-0.5		<0.001-<0.100	<0.02J-<0.5J	NA	NA	NA	NA	NA	<0.2-<10	NA	NA	<0.01-<0.5
PCBs	0.05-0.06	0.5-0.6	10	<0.020-<0.100	<0.5	<5	<0.6	<0.5	<0.5	NA	<10	NA	NA	<0.1-<0.5

□ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.

TABLE 5-5. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island — Site: Garage (SS14) — Matrix: Soil/Sediment — Units: mg/kg — METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples						Field Blank			Lab Blanks
					S04-2	SD01						EB05		
Laboratory Sample ID Numbers					4301-7	4301-4						4303-5		4301 4303
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg						µg/L		µg/L
Aluminum	0.35	2		1,500-25,000	2,100	2,000						<100		<100
Antimony	N/A	52-53		<7.8-<230	<52	<53						<100		<100
Arsenic	0.11	5.2-5.3		<4.9-8.5	<5.2	<53						<100		<100
Barium	0.024	1		27-390	20	29						<50		<50
Beryllium	N/A	2.6-2.7		<2.6-6.4	<2.6	<2.7						<50		<50
Cadmium	0.33	2.6-2.7		<3.0-<36	<2.6	<2.7						<50		<50
Calcium	0.69	4		360-59,000	9,300J	4,400J						<200		<200
Chromium	0.066	1		<4.3-47	5.1	53						<50		<50
Cobalt	N/A	5.2-5.3		<5.1-12	<5.2	<5.3						<100		<100
Copper	0.045	1		<2.7-45	4.9	16						<50		<50
Iron	0.50	2		5,400-35,000	6,500	6,400						200		<100
Lead	0.13	2		<5.1-22	16J	231J						<100		<100
Magnesium	0.96	4		360-7,400	4,500J	1,900J						<200		<200
Manganese	0.025	1		25-290	63	50						<50		<50
Molybdenum	N/A	2.6-2.7		<2.5-<11	<2.6	<2.7						<50		<50
Nickel	0.11	1		4.2-46	5.1	5.6						<50		<50
Potassium	23	100		<300-2,200	300	310						<5,000		<5,000

☐ CT&E Data.
N/A Not available.
J Result is an estimate.

TABLE 5-5. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Garage (SS14)

Matrix: Soil/Sediment
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples						Field Blank			Lab Blanks
					S04-2	SD01						EB05		
Laboratory Sample ID Numbers					4301-7	4301-4						4303-5		4301 4303
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg						µg/L		µg/L
Selenium	1.2	5.3-52		<7.8-<170	<52	<5.3						<100		<100
Silver	0.53	2.6-2.7		<3-<110	<2.6J	<2.7J						<50		<50
Sodium	0.55	5		<160-680	66	110						<250		<250-267
Thallium	0.011	0.25-1.4		<0.2-<1.2	<0.25	<1.4						<5		<5
Vanadium	0.036	1		6.3-59	7.5	6.6						<50		<50
Zinc	0.16	1		9.2-95	35	200						<50		<50

☐ CT&E Data.
J Result is an estimate.

TABLE 5-5. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Garage (SS14)
Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks		Lab Blanks	
					2S05-2	2S07-4	2S08-3	AB03	EB07		
Laboratory Sample ID Numbers					1706 4616-1	1710 4616-3	1708 4616-2	1712	1715 1716 4616-9	#5-9693 #1&2-9693 #1&2-9493 4616	#5-9593 #3&4-9693 4616
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00-20	50-200	500[a]	9.55-1,150	<200J[b]	4,820[c]	<50J[b]	NA	<200[d]	<1,000J	<4.0
GRPH	0.2-0.400	0.400-4	100	<0.4-<9	<4J[b]	358[c]	<2J[b]	<50J[b]	<20[d]	NA	<0.400-<2J
RRPH (Approx.)	10-40	100-400	2,000[a]	<480	<400	<120	<100	NA	<2,000	<2,000	NA
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.15	5.8JN	<0.10				
Benzene	0.002-0.003	0.02-0.03	0.5	<0.020-<0.300	<0.03	1.4N	<0.02	<1	<1	NA	<0.02
Toluene	0.002-0.003	0.02-0.03		<0.020-<0.300	<0.03	2.3J	<0.02	<3J	<2J	NA	<0.02
Ethylbenzene	0.002-0.003	0.02-0.03		<0.020-<0.300	<0.03	0.4J	<0.02	<2J	<1	NA	<0.02
Xylenes (Total)	0.004-0.006	0.04-0.06		<0.040-<0.600	<0.06	1.7J	<0.04	<5J	<2	NA	<0.04
VOC 8260											
Benzene	0.020	0.020-0.400	0.5	<0.025-<0.500	0.072	<0.400	<0.020	NA	<1	<1	<0.020
n-Butylbenzene	0.020	0.020-0.400		<0.025-<0.500	<0.040	3.10	<0.02	NA	<1	<1	<0.020
sec-Butylbenzene	0.020	0.020-0.400		<0.025-<0.500	<0.040	1.28	<0.02	NA	<1	<1	<0.020

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification."
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c This sample was analyzed by F&B also; DRPH and GRPH were detected at 8,460J[b] and 700J[b] mg/kg, respectively.
d This sample was analyzed by F&B also; DRPH and GRPH were detected at <1,000J[b] and <50J[b] µg/L, respectively.

TABLE 5-5. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Garage (SS14)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks		Lab Blanks	
					2S05-2	2S07-4	2S08-3	AB03	EB07		
Laboratory Sample ID Numbers					1706 4616-1	1710 4616-3	1708 4616-2	1712	1715 1716 4616-9	4616	4616
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	mg/kg
cis-1,2-Dichloroethene	0.020	0.020-0.400		<0.025-<0.500	0.069	<0.400	<0.020	NA	<1	<1	<0.020
Ethylbenzene	0.020	0.020-0.0400		<0.025-<0.500	<0.040	0.550	<0.020	NA	<1	<1	<0.020
Isopropylbenzene	0.020	0.020-0.400		<0.025-<0.500	<0.040	0.637	<0.020	NA	<1	<1	<0.020
p-Isopropyltoluene	0.020	0.020-0.400		<0.025-<0.500	<0.040	2.03	<0.02	NA	<1	<1	<0.020
Methylene Chloride	0.020	0.020-0.400	90	<0.025-<0.500	<0.040	<0.400	0.031B	NA	8.3	<1	<0.020
Naphthalene	0.020	0.020-0.400		<0.025-<0.500	<0.040	46.0	<0.02	NA	<1	<1	<0.020
n-Propylbenzene	0.020	0.020-0.400		<0.025-<0.500	<0.040	1.17	<0.02	NA	<1	<1	<0.020
Tetrachloroethene	0.020	0.020-0.400		<0.025-<0.500	<0.040	<0.400	0.023	NA	<1	<1	<0.020
Toluene	0.020	0.020-0.400		<0.025-<0.500	0.134	<0.400	<0.02	NA	1.7	<1	<0.020
1,2,4-Trimethylbenzene	0.020	0.020-0.400		<0.025-<0.500	<0.040	13.3	<0.02	NA	<1	<1	<0.020
1,3,5-Trimethylbenzene	0.020	0.020-0.400		<0.025-<0.500	<0.040	2.93	<0.02	NA	<1	<1	<0.020
Xylenes (Total)	0.040	0.040-0.800		<0.500-<1.000	<0.080	4.98	<0.04	NA	<2	<2	<0.040
Total BTEX			10	<0.125-<2.500	0.206	5.53	<0.10				

☐ CT&E Data.
NA Not analyzed.
B The analyte was found in the associated blank.

TABLE 5-5. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island | Site: Garage (SS14) | Matrix: Sediment | Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Sample				Field Blanks			Lab Blanks	
					SD01				AB02	EB05	TB05		
Laboratory Sample ID Numbers					349 4301-4				315 4303-1	332 392 4303-5	375	#3&4-82493 #1&2-82493 4303	#6-82393 #1&2-82493 4301
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg				µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	70	700	500[a]	9.55-1,150	5,100J[b]				NA	<1,000[b]	NA	NA	<50J
GRPH	0.2	2	100	<0.400-<9.0	390J[b]				<100J[b]	<100J[b]	<50J[b]	<50J-<100J	<2J
RRPH (Approx.)	70	700	2,000[a]	<480	13,000				NA	<1,000	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	59J								
Benzene	0.03	0.3	0.5	<0.020-<0.300	<0.3				<1	<1	<1	<1	<0.02J
Toluene	0.03	0.3		<0.020-<0.300	1				<1	<1	<1	<1	<0.02
Ethylbenzene	0.03	0.3		<0.020-<0.300	11				<1	<1	<1	<1	<0.02
Xylenes (Total)	0.06	0.6		<0.040-<0.600	47J				<2	<2	<2	<2	<0.04
HVOC (8010 Mod.)	0.03	0.3		<0.5J	<0.3				<1	<1	<1	<1	<0.02J
VOC 8260													
n-Butylbenzene	0.020	0.200		<0.025-<0.500	4.22				<1	<1	NA	<1	<0.020
sec-Butylbenzene	0.020	0.200		<0.025-<0.500	1.24				<1	<1	NA	<1	<0.020
tert-Butylbenzene	0.020	0.200		<0.025-<0.500	0.256				<1	<1	NA	<1	<0.020
Ethylbenzene	0.020	0.200		<0.025-<0.500	0.728				<1	<1	NA	<1	<0.020
Isopropylbenzene	0.020	0.200		<0.025-<0.500	0.681				<1	<1	NA	<1	<0.020

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE 5-5. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Sediment
Site: Garage (SS14) Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Sample				Field Blanks			Lab Blanks	
					SD01				AB02	EB05	TB05		
Laboratory Sample ID Numbers					349 4301-4				315 4303-1	332 392 4303-5	375	4303	4301
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg				µg/L	µg/L	µg/L	µg/L	mg/kg
p-Isopropyltoluene	0.020	0.200		<0.025-<0.500	2.47				<1	<1	NA	<1	<0.020
Naphthalene	0.020	0.200		<0.025-<0.500	14.9				<1	<1	NA	<1	<0.020
n-Propylbenzene	0.020	0.200		<0.025-<0.500	0.918				<1	<1	NA	<1	<0.020
1,2,4-Trimethylbenzene	0.020	0.200		<0.025-<0.500	14.7				<1	<1	NA	<1	<0.020
1,3,5-Trimethylbenzene	0.020	0.200		<0.025-<0.500	9.32				<1	<1	NA	<1	<0.020
Xylenes (Total)	0.040	0.400		<0.050-<1.000	10.3				<2	<2	NA	<2	<0.040
SVOC 8270													
2-Methylnaphthalene	0.200	2.20		<0.230-<3.50	14.5				NA	<11	NA	<10	<0.200
Phenanthrene	0.200	2.20		<0.230-<3.50	4.79				NA	<11	NA	<10	<0.200
bis(2-Ethylhexyl) Phthalate	0.200	2.20	50	<0.230-<3.50	4.6				NA	<11	NA	<10	<0.200
Fluoranthene	0.200	2.20		<0.230-<3.50	2.28				NA	<11	NA	<10	<0.200
Isophorone	0.200	2.20		<0.230-<3.50	1.49J				NA	<11	NA	<10	<0.200
Naphthalene	0.200	2.20		<0.230-<3.50	7.73				NA	<11	NA	<10	<0.200

☐ CT&E Data.
NA Not analyzed.
J Results in an estimate.

TABLE 5-5. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island   Matrix: Surface Water
Site: Garage (SS14)   Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Sample						Field Blanks			Lab Blanks
					SW01						AB02	EB05	TB05	
Laboratory Sample ID Numbers					336/333 4301-1						315 4303-1	332 392 4303-5	375	#6-82393 #5-82493 #3&4-82493 #1&2-82493 4303 4301
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L						µg/L	µg/L	µg/L	µg/L
DRPH	100	1,000		<200	<1,000J[b]						NA	<1,000[b]	NA	NA
GRPH	10	100		<20	<100J[b]						<100J[b]	<100J[b]	<50J[b]	<50J-<100J
RRPH (Approx.)	200	2,000		NA	<2,000						NA	<1,000	NA	NA
BTEX (8020/8020 Mod.)														
Benzene	0.1	1	5	<1	<1						<1	<1	<1	<1
Toluene	0.1	1	1,000	<1	<1						<1	<1	<1	<1
Ethylbenzene	0.1	1	700	<1	<1						<1	<1	<1	<1
Xylenes (Total)	0.2	2	10,000	<2	8J						<2	<2	<2	<2
HVOC (8010 Mod.)	0.1	1		NA	<1						<1	<1	<1	<1
SVOC 8270	10	25		<10	<25						NA	<11	NA	<10
Pesticides	0.2	2		<1	<2J-<50J						NA	<0.2-<10	NA	NA

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE 5-5. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Garage (SS14)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample								Field Blank			Lab Blanks
					SW01									EB05		
Laboratory Sample ID Numbers					4301-1									4303-5		4301 4305
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L									µg/L		µg/L
Aluminum	17.4	100		<100-350 (<100-340)	<100 (<100)									<100		<100 (<100)
Antimony	N/A	100	6	<100 (<100)	<100 (<100)									<100		<100 (<100)
Arsenic	5.3	100	50	<100 (<100)	<100 (<100)									<100		<100 (<100)
Barium	1.2	50	2,000	<50-93 (<50-91)	74 (62)									<50		<50 (<50)
Beryllium	N/A	50	4	<50 (<50)	<50 (<50)									<50		<50 (<50)
Cadmium	1.7	50	5	<50 (<50)	<50 (<50)									<50		<50 (<50)
Calcium	34.5	100		4,500-88,000 (4,100-86,000)	105,000 (110,000)									<200		<200-378 (378)
Chromium	3.29	50	100	<50 (<50)	<50 (<50)									<50		<50 (<50)
Cobalt	N/A	100		<100 (<100)	<100 (<100)									<100		<100 (<100)
Copper	2.3	50	1,300	<50 (<50)	<50 (<50)									<50		<50 (<50)
Iron	25	100		180-2,800 (<100-1,600)	6,000 (5,500)									200		<100 (<100)

☐ CT&E Data.
N/A Not available.

TABLE 5-5. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Garage (SS14)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample							Field Blank			Lab Blanks
					SW01								EB05		
Laboratory Sample ID Numbers					4301-1								4303-5		4301 4305
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L								µg/L		µg/L
Lead	6.6	100	15	<100 (<100)	<100J (<100)J								<100		<100 (<100)
Magnesium	47.8	100		<5,000-53,000 (2,600-54,000)	34,000 (32,000)								<200		<200 (<200)
Manganese	1.24	50		<50-210 (<50-120)	490 (460)								<50		<50 (<50)
Molybdenum	N/A	50		<50 (<50)	<50 (<50)								<50		<50 (<50)
Nickel	5.5	50	100	<50 (<50)	<50 (<50)								<50		<50 (<50)
Potassium	1,154	100		<5,000 (<5,000)	9,100 (8,200)								<5,000		<5,000 (<5,000)
Selenium	62.4	100	50	<100 (<100)	<100 (<100)								<100		<100 (<100)
Silver	2.6	50	50	<50 (<50)	<50 (<50)								<50		<50 (<50)
Sodium	27.7	100		8,400-410,000 (8,200-450,000)	130,000 (140,000)								<250		<250-267 (<250)
Thallium	0.57	5	2	<5 (<5)	<5 (<5)								<5		<5 (<5)

☐ CT&E Data.
N/A Not available.
J Result is an estimate.

TABLE 5-5. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island   Matrix: Surface Water   METALS ANALYSES: TOTAL (DISSOLVED)
Site: Garage (SS14)   Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample								Field Blank			Lab Blanks
					SW01									EB05		
Laboratory Sample ID Numbers					4301-1									4303-5		4301 4305
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L									µg/L		µg/L
Vanadium	1.8	50		<50 (<50)	<50 (<50)									<50		<50 (<50)
Zinc	8.2	50		<50-160 (<50)	<50 (<50)									<50		<50 (<50)

☐ CT&E Data.

TABLE 5-6. IDENTIFICATION OF CONTAMINANTS OF CONCERN AT THE GARAGE (SS14)

SITE	MATRIX	CHEMICAL DETECTED[a]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[b]		ARAR[c]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Garage (SS14)	Soil	DRPH	12,400	mg/kg	9.55-1,150	–	–	500[d]	YES
		GRPH	700	mg/kg	<0.400-<9	–	–	100[d]	YES
		RRPH	27,000	mg/kg	<480	–	–	2,000[d]	YES
		Benzene	1.4	mg/kg	<0.020-<0.500	2.2	–	0.5[d]	YES
		n-Butylbenzene	4.22	mg/kg	<0.025-<0.500	–	–	–	NO
		sec-Butylbenzene	1.28	mg/kg	<0.025-<0.500	–	–	–	NO
		tert-Butylbenzene	0.256	mg/kg	<0.025-<0.500	–	–	–	NO
		cis-1,2-Dichloroethene	0.069	mg/kg	<0.025-<0.500	–	270	–	NO
		Ethylbenzene	11	mg/kg	<0.020-<0.500	–	2,700	–	NO
		Isopropylbenzene	0.681	mg/kg	<0.025-<0.500	–	–	–	NO
		p-Isopropyltoluene	2.47	mg/kg	<0.025-<0.500	–	–	–	NO
		Naphthalene	46	mg/kg	<0.025-<3.50	–	100	–	NO
		n-Propylbenzene	1.17	mg/kg	<0.025-<0.500	–	–	–	NO
		Tetrachloroethene	0.023	mg/kg	<0.020-<0.500	1.23	270	–	NO
		Toluene	2.3	mg/kg	<0.020-<0.500	–	5,400	–	NO
		1,2,4-Trimethylbenzene	14.7	mg/kg	<0.025-<0.500	–	–	–	NO
		1,3,5-Trimethylbenzene	9.32	mg/kg	<0.025-<0.500	–	–	–	NO
		Xylenes	47	mg/kg	<0.040-<1.000	–	54,000	–	NO

a The concentrations reported for metals in surface water are total metals.
b Risk-Based Screening Level.
c Applicable or Relevant and Appropriate Requirement.
d ADEC 1991.
e EPA 1989d.
f MCL, 56 FR 3526 (30 January 1991).
g MCL, 56 FR 30266 (01 July 1991).

TABLE 5-6. IDENTIFICATION OF CONTAMINANTS OF CONCERN AT THE GARAGE (SS14) (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED[a]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[b]		ARAR[c]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Garage	Soil	Isophrone	1.49	mg/kg	<0.230-<3.50	67.4	5,400	--	NO
(SS14)	(Continued)	2-Methylnaphthalene	14.5	mg/kg	<0.230-<3.50	--	--	--	NO
(Continued)		Phenanthrene	4.79	mg/kg	<0.230-<3.50	--	--	--	NO
		Fluoranthene	2.28	mg/kg	<0.230-<3.50	--	1,080	--	NO
		bis(2-Ethylhexyl)Phthalate	4.6	mg/kg	<0.230-<3.50	4.57	540	--	YES
		Aluminum	2,100	mg/kg	1,500-25,000	--	--	--	NO
		Barium	29	mg/kg	27-390	--	1,890	--	NO
		Calcium	9,300	mg/kg	360-59,000	--	--	--	NO
		Chromium	53	mg/kg	<4.3-47	--	135	--	NO
		Copper	16	mg/kg	<2.7-45	--	999	--	NO
		Iron	6,500	mg/kg	5,400-35,000	--	--	--	NO
		Lead	231	mg/kg	<5.1-22	--	--	500[e]	NO
		Magnesium	4,500	mg/kg	360-7,400	--	--	--	NO
		Manganese	63	mg/kg	25-290	--	3,780	--	NO
		Nickel	5.6	mg/kg	4.2-46	--	540	--	NO
		Potassium	310	mg/kg	<300-2,200	--	--	--	NO
		Sodium	110	mg/kg	<160-680	--	--	--	NO
		Vanadium	7.5	mg/kg	6.3-59	--	189	--	NO
		Zinc	200	mg/kg	9.2-95	--	8,100	--	NO

a The concentrations reported for metals in surface water are total metals.
b Risk-Based Screening Level.
c Applicable or Relevant and Appropriate Requirement.
d ADEC 1991.
e EPA 1989d.
f MCL, 56 FR 3526 (30 January 1991).
g MCL, 56 FR 30266 (01 July 1991).

TABLE 5-6. IDENTIFICATION OF CONTAMINANTS OF CONCERN AT THE GARAGE (SS14) (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED[a]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[b]		ARAR[c]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Garage	Water	Xylenes	8	µg/L	<2	--	7,300	10,000[f]	NO
(SS14)		Barium	74	µg/L	<50-93	--	256	2,000[g]	NO
(Continued)		Calcium	110,000	µg/L	4,100-88,000	--	--	--	NO
		Iron	6,000	µg/L	<100-2,800	--	--	--	NO
		Magnesium	34,000	µg/L	<5,000-54,000	--	--	--	NO
		Manganese	490	µg/L	<50-510	--	18.3	--	NO
		Potassium	9,100	µg/L	<5,000	--	--	--	NO
		Sodium	140,000	µg/L	8,200-450,000	--	--	--	NO

a The concentrations reported for metals in surface water are total metals.
b Risk-Based Screening Level.
c Applicable or Relevant and Appropriate Requirement.
d ADEC 1991.
e EPA 1989d.
f MCL, 56 FR 3526 (30 January 1991).
g MCL, 56 FR 30266 (01 July 1991).

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5.4 WHITE ALICE FACILITY (SS16)

5.4.1 Site Background

The White Alice Facility (SS16) site is located 1,600 feet south of the module trains, and previously was a communication transmission and receiving unit for the station. The site consists of a radio relay building and two large White Alice "billboards" that look like outdoor movie screens. It was suspected that dielectric fluids containing PCBs were discharged to the surrounding surface soils in small quantities during maintenance of the facility equipment.

The site-specific environmental setting describing the topography, surface water drainage, and soil types is presented in the discussion of potential migration pathways, Section 5.4.3.

5.4.2 Field Sampling and Analytical Results

This section describes the RI sampling and analytical results for samples collected at the White Alice Facility site. The discussion presents a review of laboratory data, data summary tables, contaminants identified, contaminant trends, and information on suspected source areas.

5.4.2.1 Summary of Samples Collected. A total of 11 soil samples was collected adjacent to doorways and within adjacent drainage pathways at the White Alice Facility (SS16) site. Table 2-2 presents a detailed summary of the samples collected and the analyses performed during the 1993 RI field activities. Locations of all samples collected at the White Alice Facility (SS16) site and a summary of analytical results above background levels are presented in Figure 5-5.

The 11 soil samples were analyzed for PCBs. In addition, four samples were also analyzed for DRPH and RRPH.

5.4.2.2 Analytical Results. The data summary table (Table 5-7) presents analytical results for all samples collected at the site. Detection and quantitation limits, action levels, associated laboratory and field blanks, and background analytical results are presented for each of the analyses. Background levels are listed to allow comparison of naturally occurring organic compounds with samples collected from the site. Sample locations and analytical results for the samples collected at the site are illustrated in Figure 5-5. All organic compounds detected are presented on the figure except when they were a result of laboratory contamination or field decontamination procedures. The exceptions are presented on the data summary table. The following section presents a discussion of organic compounds detected at the site.

Organics. Organic compounds detected in soil and sediment samples collected at the site are limited to Aroclor 1254 (a group of PCBs). Aroclor 1254 was detected in three samples ranging from 8.7 to 52 mg/kg (samples SS16-S01, SS16-S06/S07, and SS16-2S09).

Inorganics. Metals were not a concern at the site, and no metals analyses were performed.

5.4.2.3 Summary of Site Contamination. The suspected source of the PCBs, Aroclor 1254, detected during sampling conducted at the White Alice Facility is spills and/or leaks from the transformer at the site. The contaminated soil samples were collected adjacent to the concrete pad on which the transformer is placed. PCB contamination was not detected below one foot in depth, so the affected area appears to be localized. No previous sampling had been conducted at the site. Based on field data, source of contamination, and concentration of contaminants, the area of significantly contaminated soil is limited to 16 square feet of the gravel pad area adjacent to the concrete pad next to the transformer drain valve. The human health and ecological risks associated with the chemicals detected at the site are presented in Sections 5.4.4 and 5.4.5.

5.4.3 Migration Pathways

This section describes the topography and stratigraphy of the site and the migration potential of contaminants from the site. A discussion of receptors and chemical concentrations at receptors is included.

5.4.3.1 Topography and Stratigraphy. The topography at the site consists of relatively flat tundra, upon which a gravel pad is placed (Figure 5-5). The White Alice Building is located in the center of this gravel pad. Surface drainage is radially away from the center of the gravel pad and into the tundra.

During the 1993 RI, permafrost was located at a depth of approximately two and a half feet in tundra areas and four feet under gravel pads. Gravel pad materials consisted of the typical gravels and sands associated with these features, and subsurface tundra materials were the typical stratigraphy found at Barter Island (Section 2.4.4.2).

5.4.3.2 Migration Potential.

Subsurface Migration. Topography indicates that any subsurface flow should be radially away from the center of the gravel pad. Because PCBs are relatively insoluble and were detected only in the shallow samples near the concrete pad, the potential for subsurface migration is considered to be minimal.

Surface Migration. There are no distinct surface drainage features in the immediate vicinity of the site. Because PCBs were detected only near the center of the gravel pad and are relatively insoluble, the potential for surface migration is considered to be minimal.

Air Transport. Air transportation is not considered to be a significant mode of migration at the site (Section 2.4.4.5).

Summary of Migration Potential. The occurrence of PCBs at the site is extremely limited and confined to the gravel pad area adjacent to a site transformer. Because PCBs are relatively insoluble and tend to bind to soil particles, the potential for transport is considered to be minimal.

5.4.3.3 Receptors and Chemical Concentrations at Receptors.

Human Receptors. Potential human receptors at the White Alice Facility site include Air Force contractor personnel working at the station, visitors to the station, and an occasional local visitor passing the site to get to recreational or subsistence lands. Human receptors could potentially be exposed to the chemicals detected in soils/sediments at the site. The primary routes of potential exposures at the site are direct contact with soils/sediments and incidental ingestion of soils/sediments. Surface water was not considered a route of exposure at the site because no surface waters are associated with the site. Because groundwater and air at the Barter Island sites are not considered complete pathways of exposure, these media are not evaluated as potential pathways to human receptors.

The Barter Island Risk Assessment (U.S. Air Force 1996) evaluates in detail the risks to human health from all COCs detected at the site. The potential receptor groups were selected based on their likelihood of exposure to contaminants at the site and include DEW Line workers at the installation, and native adults and children who may visit the site. The estimated exposure point concentrations for human receptors are based on the maximum concentration of each chemical detected at the site. The potential risks to human health associated with site chemicals at Barter Island are presented in Section 5.5.4.

Ecological Receptors. Ecological receptors were evaluated in detail in the Barter Island Risk Assessment (U.S. Air Force 1996) to determine if plants and animals could potentially be impacted by the chemicals detected at the Barter Island installation. Because of the diversity of the plants and animals in the area of the Barter Island installation, a set of representative species were selected in the ERA for detailed evaluation. The species include plants, aquatic invertebrates, fish, birds, and mammals. These receptors were selected based on the species' likelihood of exposure given their preferred habitat and feeding habits. The representative species encompass a range of ecological niches in order to achieve the best characterization of the ecosystems being examined and are presented in Table 2-6.

The estimate of chemical concentrations at the ecological receptors was based on the average site-wide concentration of each COC. This approach was appropriate because few of the representative species would inhabit only one distinct site at the installation; they are more likely to be exposed to the mix of chemicals and concentrations detected on all the sites at Barter Island. The potential ecological risks associated with the chemicals detected at the site are presented in Section 5.4.5.

5.4.4 Human Health Risk Assessment

This section presents a summary of the potential human health risks associated with the chemicals detected at the White Alice Facility (SS16) site. The purpose of the human health risk assessment is to quantify the excess lifetime cancer risk and/or the noncancer hazard (reported as hazard index) from the contaminants detected at the site.

This summary presents the COCs at the site, the pathways by which human receptors may be exposed to site chemicals, potential risks to human health posed by each chemical through each

exposure pathway, the significance of the risk and/or hazard estimate, and a comparison of site chemical concentrations to ARARs. The methods and assumptions used in calculating hazards and risks are presented in Section 2.4.1.

5.4.4.1 Chemicals of Concern. At the White Alice Facility (SS16), the only COC identified in the soil/sediment at the site was Aroclor 1254. No surface water bodies were associated with the site; therefore, no surface water samples were collected.

Table 5-8, Identification of COCs at the White Alice Facility, presents the maximum concentrations of chemicals detected at the site and the associated background concentrations, RBSLs, and ARARs, and identifies the COCs selected in the risk evaluation.

5.4.4.2 Exposure Pathways and Potential Receptors. Because no surface water bodies are associated with the White Alice Facility site, only soil/sediment ingestion pathways were considered in the risk assessment.

Three potential receptor groups were evaluated in the risk assessment: an adult assigned to a DEW Line installation (worker), an adult inhabitant of communities in the North Slope of Alaska (native), and a child living in a North Slope community (child).

5.4.4.3 Risk Characterization.

Noncancer Hazard and Cancer Risk Associated with Soils and Sediments. The noncancer hazard associated with the ingestion of soil at the White Alice Facility (SS16) site by a hypothetical native northern adult/child is 3.155, and by a DEW Line worker is 0.153, based on the maximum concentration of the COC. The presence of Aroclor 1254 accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations.

The excess lifetime cancer risk associated with the ingestion of soil at the site by a hypothetical native northern adult/child is 7×10^{-5}, and by a DEW Line worker is 3×10^{-6}, based on the maximum concentration of the COC. The presence of PCBs (Aroclor 1254) accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

Noncancer Hazard and Cancer Risk Associated with Surface Water. No surface water bodies were identified at the White Alice Facility (SS16). Therefore, there is no apparent surface water pathway, and no evaluation of noncancer hazard or excess lifetime cancer risk associated with ingestion of surface water at the site was conducted.

5.4.4.4 Summary of Human Health Risk Assessment. The presence of PCBs (Aroclor 1254) in the gravel pad at the White Alice Facility (SS16) accounts for the quantifiable noncancer hazard (hazard indices of 3.155 and 0.153) and cancer risk (7×10^{-5} and 3×10^{-6}). Although the noncancer hazard exceeds one and the cancer risk exceeds 1×10^{-6}, these risks and hazards were estimated based on ingestion of soil at a rate associated with a residential scenario. The contaminated gravel at the site is estimated at less than two cubic yards, and it is very unlikely that soil at this location would be ingested at the conservative rate used in the risk calculation. In addition, the hazards and risks at the site are based on the maximum concentrations detected

at the site and assumes the concentrations will remain constant. Therefore, the hazards and risks at the site are likely to be overestimated. Remedial action is generally not warranted at sites where the excess lifetime cancer risk is less than 1×10^{-4}, and on the bases of carcinogenic risk alone, remediation of the site is not necessarily warranted (EPA 1991c). In conclusion, under current site uses the COCs at the White Alice Facility are not likely to pose a potential threat to human health.

5.4.5 Ecological Risk Assessment

The objective of the ERA is to estimate the potential impacts of chemicals detected at the installation to aquatic and terrestrial plants and animals. A summary of the methods used to assess potential ecological impacts is presented in Section 2.4.2.

5.4.5.1 Chemicals of Concern. COCs for the ERA were selected based on the average installation-wide concentration of chemicals detected at the Barter Island sites. Only sites where useable habitat exists and that were likely to be used by ecological receptors were included in the ecological risk evaluation. The White Alice Facility (SS16) site was determined not to be usable habitat for ecological receptors because the contaminated portion of the site consists only of a very limited area of gravel pad.

Because the site was determined not to be suitable habitat, no evaluation of ecological risks was conducted for the White Alice Facility (SS16).

5.4.5.2 Summary of Ecological Risk Assessment. The White Alice Facility site was not evaluated in the ERA because it did not provide suitable habitat for potential ecological receptors. Exposures to COCs by the representative species are not expected. However, PCBs were detected at levels above screening levels. It is possible that if the site were abandoned and revegetation occurred, that ecological receptors could be exposed to the PCBs. In addition, PCBs have a high potential for bioaccumulation. It is possible that risks posed by PCBs at the White Alice Facility could be significant in the future. Refer to Section 3.4.5, Potential Future Risks, in the Barter Island ERA (U.S. Air Force 1996) for a more thorough discussion of potential future risks associated with PCBs.

5.4.6 Conclusions and Recommendation

Sampling and analyses have determined that the White Alice Facility (SS16) site is contaminated with Aroclor 1254, a group of PCBs. The contaminated area at the site is the gravel pad below a concrete pad in which a transformer is located. The likely source of contamination is a former spill and/or leak of transformer fluid. Currently, the transformer does not contain PCBs.

Migration of contaminants from the site appears to have been minimal. Contaminated gravel is limited to approximately sixteen square feet to the south and east of the concrete transformer pad. The potential for migration of contaminants is not anticipated as the site is relatively flat and PCBs tend to bind tightly with soil particles.

The risk assessment concluded that risks posed to human health and ecological receptors by site contaminants are minimal given current site uses. A potential human health risk was identified based on levels of Aroclor 1254 at the site. However, the risks and hazards were calculated conservatively based on a future residential scenario and are probably overestimated. Therefore, under current site conditions and considering the findings of the risk assessment, remediation of the site is not necessarily warranted.

Levels of PCBs detected in gravel at the site exceed regulatory cleanup levels and can potentially bioaccumulate in the environment. Therefore, the site is being recommended for remedial action. The contaminated area at the site consists of approximately two cubic yards of gravel. The remedial action alternative recommended for the site is excavation and offsite incineration. A complete description and evaluation of the remedial alternatives considered for this site are presented in the Feasibility Study, Section 6.0.

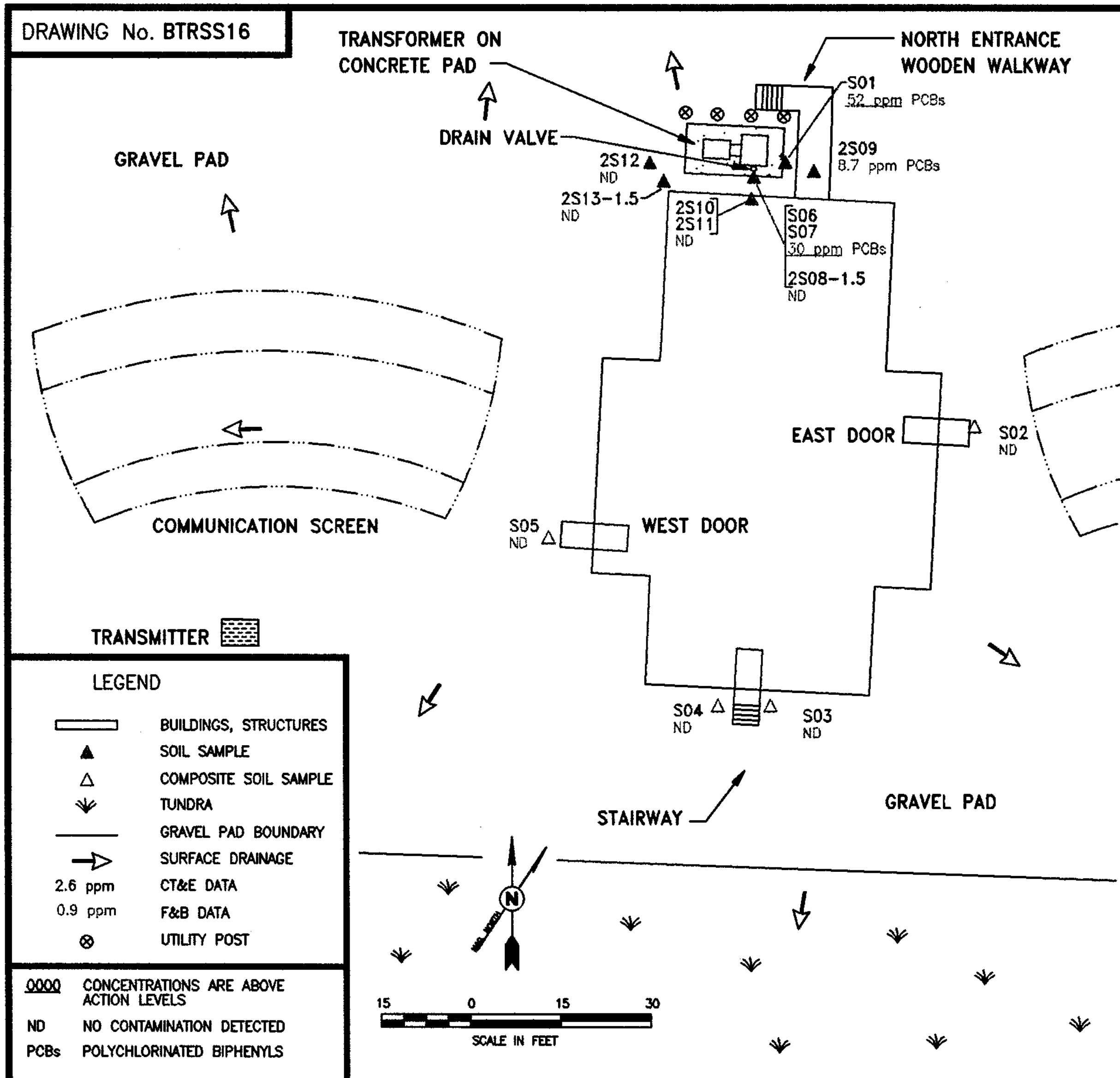

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FIGURE NO. 5-5

WHITE ALICE FACILITY (SS16) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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TABLE 5-7. WHITE ALICE FACILITY ANALYTICAL DATA SUMMARY

Installation: Barter Island
Site: White Alice Facility (SS16)
Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples							Field Blanks			Lab Blanks	
					S01	S02 Composite	S03 Composite	S04 Composite	S05 Composite	S06 & (Replicates)	S07	AB02	EB05	TB05		
Laboratory Sample ID Numbers					320	321	370	371	372	373	374	315	392 332	375	#5-82493	#6-82393
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5	50	500[a]	9.55-1,150	NA	NA	<50J[b]	<50J[b]	<50J[b]	<50J[b]	<50J[b]	NA	<1,000[b]	NA	NA	<50J
RRPH (Approx.)	10-20	100-200	2,000[a]	<480	NA	NA	<100	<100	<100	<200	<200	NA	<1,000	NA	NA	<100
PCBs																
Aroclor 1254	0.01-0.05	0.1-0.5	10	<0.020-<0.100	52J	<0.5	<0.1	<0.1	<0.1	20J	30J	NA	<10	NA	NA	<0.1-<0.5

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH concentrations reported for these samples are equivalent to diesel range organics (DRO) as defined by ADEC.

TABLE 5-7. WHITE ALICE FACILITY ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Soil
Site: White Alice Facility (SS16) Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples							Field Blank	Lab Blank
					2S08-1.5	2S09	2S10 & 2S11 (Replicates)		2S12	2S13-1.5		EB06	
Laboratory Sample ID Numbers					1671	1672	1673	1674	1675	1676		1688 1690	#5-9493
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		µg/L	mg/kg
PCBs													
Aroclor 1254	0.05	0.5	10	<0.020-<0.100	<0.5	8.7J	<0.5	<0.5	<0.5	<0.5		<2	<0.1-<2

☐ CT&E Data.
■ F&B Data.
J Result is an estimate.

TABLE 5-8. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE WHITE ALICE FACILITY (SS16)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a]		ARAR[b]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
White Alice Facility (SS16)	Soil	Aroclor 1254	52	mg/kg	<0.020-<0.100	--	0.54	10[c]	YES

a Risk-Based Screening Level.
b Applicable or Relevant and Applicable Requirement.
c TSCA Cleanup Level.

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6.0 FEASIBILITY STUDY

The purpose of this section is to present the FS of remedial alternatives for the sites at Barter Island recommended for remedial action. These sites were identified based on the findings of the RI, reported in Sections 1.0 through 5.0 of this document, and the Barter Island Risk Assessment (U.S. Air Force 1996). The Barter Island sites recommended for remedial action and covered by this FS are:

- POL Catchment (LF03);
- Heated Storage (SS13);
- Garage (SS14); and
- White Alice Facility (SS16).

Complete RI results for these sites are presented in Section 5.0. The COCs at each of these sites are presented in Table 6-1. The COCs at each of these sites were based on the conclusions of the risk assessment. This FS describes the evaluation of remedial alternatives used as the basis for the selection of the proposed remedial actions for the sites presented in Section 5.0.

Sites requiring no further action based on the RI and Risk Assessment are not included in this section. The proposed no further action sites are the Old Landfill (LF01), the Current Landfill (LF04), the Contaminated Ditch (SD08), the Old Runway Dump (LF12), the Weather Station Building (SS15), the POL Tanks (ST17), the Fuel Tanks (ST18), the Old Dump Site (LF19), and the Bladder Diesel Spill (SS20). RI results for these sites are presented in Section 3.0. The JP-4 Spill (SS21) requires further characterization and is discussed in Section 4.0.

This FS complies with the NCP. It has been streamlined as described in the following section. The remainder of the introduction consists of a discussion of the streamlining approach, including risk management decisions and an outline of the organization of the FS.

6.0.1 Approach To Feasibility Study

This FS is streamlined as follows to expedite remediation and minimize unnecessary evaluation of remedial alternatives for the sites at Barter Island.

- Screening and detailed evaluation of remedial alternatives were not conducted for sites where a completely protective presumptive remedy will be employed.

  A presumptive remedy has been selected for one of the sites at Barter Island, the White Alice Facility (SS16), because approximately two cubic yards of gravel are contaminated by PCBs, Aroclor 1254. This soil will be excavated and incinerated. No further analysis of alternatives is necessary. A cost estimate and estimated project duration are presented in Section 6.4 and Attachments A and B, and the costs are included in the estimated remediation cost for the entire installation.

TABLE 6-1. CHEMICALS OF CONCERN AT THE SITES REQUIRING REMEDIAL ACTION

SITE	MATRIX	CHEMICAL DETECTED[a]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[b] CANCER	RBSL[b] NON-CANCER	ARAR[c]	CHEMICAL OF CONCERN
POL Catchment	Soil	DRPH	28,600	mg/kg	9.55-1,150	--	--	500[d]	YES
(LF03)	Water	DRPH	1770	μg/L	<200	--	292	--	YES
		GRPH	367	μg/L	<20	50	730	--	YES
		Benzene	2.7	μg/L	<1	0.617	--	5[e]	YES
Heated Storage	Soil	DRPH	3,580	mg/kg	9.55-1,150	--	--	500[d]	YES
(SS13)		GRPH	423	mg/kg	<0.400-<9	--	--	100[d]	YES
		RRPH	2,400	mg/kg	<480	--	--	2,000[d]	YES
	Water	DRPH	5,760	μg/L	<200	--	292	--	YES
		Benzene	6.9	μg/L	<1	0.617	--	5[d]	YES
		Tetrachloroethene	12	μg/L	<1	1.63	36.5	5[f]	YES
		Manganese	540	μg/L	<50-510	--	18.3	--	YES
Garage	Soil	DRPH	12,400	mg/kg	9.55-1,150	--	--	500[d]	YES
(SS14)		GRPH	700	mg/kg	<0.400-<9	--	--	100[d]	YES
		RRPH	27,000	mg/kg	<480	--	--	2,000[d]	YES
		Benzene	1.4	mg/kg	<0.020-<0.500	22	--	0.5[d]	YES
White Alice Facility (SS16)	Soil	Aroclor 1254	52	mg/kg	<0.020-<0.100	--	0.54	10[g]	YES

a The concentrations reported for metal in surface water are total metals.
b Risk-Based Screening Level.
c Applicable or Relevant and Appropriate Requirement.
d Target cleanup levels for DRPH, GRPH, and RRPH in soil are based on ADEC Non UST guidance and do not necessarily correspond to final site specific cleanup goals.
e MCL, 52 FR 25690 (08 July 1987).
f MCL, 56 FR 3526 (30 January 1991).
g TSCA Cleanup Level.

- The FS was conducted with the focus on contaminated media instead of individual sites, specifically gravel, the areas underneath buildings, and tundra.

  It would not be practical to remediate these sites individually. The sites have been aggregated by contaminated media because they are each small and similar in types of contamination, and the installation is too remote to do otherwise efficiently. In addition, developing alternatives by medium reduces unnecessary repetition.

  The areas underneath both the Heated Storage (SS13) and the Garage (SS14) are adjacent and very similar; they will be remediated as one site using the same remedial alternative. Contaminated tundra is associated with two sites, the POL Catchment (LF03) and the Heated Storage (SS13). The same remedial alternative may be used at both sites. Contaminated gravel is associated with all three sites, and one remedial alternative may be used.

- Repetition of information presented in the RI (Section 1.0 through 5.0 of this report) and Barter Island Risk Assessment was minimized. The data presented was limited to data essential to evaluating remedial alternatives by presenting that information in summary tables.

  The summary table recommended in the AFCEE Handbook (U.S. Air Force 1991a) has been adapted to focus on the data essential to the evaluation of remedial alternatives. Wherever possible, reference will be made to the RI and Risk Assessment for detailed site information, and assumptions used in calculating risk and identifying COCs.

- The number of alternatives evaluated were limited to those likely to be effective.

  General response (GRAs) actions and applicable technologies are screened together, and the alternatives are limited to no more than five proven conventional and innovative methods including the required no action alternative.

6.0.2 Risk Management Decisions

One risk management decisions was made in writing the FS, based on a thorough review of the data. It relates to surface water.

Surface water in tundra areas has been impacted by sources of contamination at the installation and is therefore included in Table 6-1. Methods for remediating surface water directly are not promising because the surface water is extremely shallow, covers a wide area, is frozen for over half the year, and is intimately associated with tundra. ADEC recognizes the benefits of leaving petroleum-contaminated tundra undisturbed in the Interim Guidance for Non-UST Contaminated Soil Cleanup Levels (Guidance No. 001 - Revision No. 1, July 17, 1991, page 10). Instead of evaluating direct remedial alternatives for surface water in otherwise natural tundra areas, we have taken the approach that remediation of the source will improve the quality of surface water

over time. The preferred remedial alternatives include a provision for sampling surface water to confirm the effectiveness of remedial actions.

By using risk management, the focus of the FS can be finding solutions to cleanup the sources of contamination at Barter Island. The primary contaminant at the installation is diesel. Other contaminants include gasoline, residual range petroleum hydrocarbons, BTEX compounds, and PCBs.

6.0.3 Organization

The FS is organized as follows:

- Introduction;
- Site Characterization for Remediation (considers COCs, ranges of chemicals detected, estimated areas and volumes of effected media, ARARs, and target cleanup levels or proposed remediation goals for each site);
- Screening of General Response Actions and Presentation of Representative Remedial Technologies;
- Development of Remedial Alternatives;
- Detailed Evaluation of Remedial Alternatives (the detailed analysis is based on the AFCEE guidance and includes analyses of the nine NCP criteria). The detailed evaluation also includes a comparative analysis of alternatives, and identification of preferred alternatives);
- Siting Study; and
- Detailed cost estimates and estimates of project duration in attachments A and B, respectively.

6.1 SITE CHARACTERIZATION FOR REMEDIATION

Information relevant to the screening and evaluation of remedial alternatives for the four sites at Barter Island is summarized in Tables 6-2 through 6-5. The tables include COCs, ranges of chemicals detected, estimates of volumes of affected media, and the basis for listing each as a COC (ARARs, risk $>10^{-6}$, or HQ >1).

TABLE 6-2. REMEDIAL ACTION CHARACTERIZATION FOR POL CATCHMENT (LF03)

MEDIA	CONTAMINANTS	RANGE OF ENVIRONMENTAL CONTAMINATION	TARGET CLEANUP LEVEL[a]	BASIS FOR LISTING AS COC	VOLUME OF CONTAMINATED MEDIA	DESIGN PARAMETERS
Gravel	DRPH	ND - 5,200 mg/kg	500 mg/kg	ADEC Non-UST Action Level	5 cubic yards (cy)	• microbial activity • oxygen diffusion • contaminant • concentration • solubility • volume • grain size • seasonal impact
Tundra (soil/sediment)	DRPH	ND - 28,600 mg/kg	500 mg/kg	ADEC Non-UST Action Level	2,500 cy	• microbial activity • contaminant • concentration • effect of lime on enzymes • area affected

[a] Target cleanup levels for DRPH, GRPH, and RRPH in soil are based on ADEC Non UST guidance and do not necessarily correspond to final site specific cleanup goals.

TABLE 6-3. REMEDIAL ACTION CHARACTERIZATION FOR HEATED STORAGE (SS13)

MEDIA	CONTAMINANTS	RANGE OF ENVIRONMENTAL CONTAMINATION	TARGET CLEANUP LEVEL[a]	BASIS FOR LISTING AS COC	VOLUME OF CONTAMINATED MEDIA	DESIGN PARAMETERS
Gravel	DRPH	116 - 797 mg/kg	500 mg/kg	ADEC Non-UST Action Level	50 cy	• microbial activity • oxygen diffusion • contaminant • concentration • solubility • volume • grain size • seasonal impact
Area Underneath Bldg.	DRPH	1,290 - 3,580 mg/kg	500 mg/kg	ADEC Non-UST Action Level	110 cy	• accessibility • contaminant • concentration • solubility • drainage
	GRPH	ND - 423 mg/kg	100 mg/kg	ADEC Non-UST Action Level		
Tundra (soil/sediment)	DRPH	ND - 770 mg/kg	500 mg/kg	ADEC Non-UST Action Level	232 cy	• microbial activity • contaminant • concentration • effect of lime on enzymes • area affected
	RRPH	ND - 2,400 mg/kg	2,000 mg/kg	ADEC Non-UST Action Level		

[a] Target cleanup levels for DRPH, GRPH, and RRPH in soil are based on ADEC Non UST guidance and do not necessarily correspond to final site specific cleanup goals.

TABLE 6-4. REMEDIAL ACTION CHARACTERIZATION FOR THE GARAGE (SS14)

MEDIA	CONTAMINANTS	RANGE OF ENVIRONMENTAL CONTAMINATION	TARGET CLEANUP LEVEL[a]	BASIS FOR LISTING AS COC	VOLUME OF CONTAMINATED MEDIA	DESIGN PARAMETERS
Gravel	DRPH	ND - 12,400 mg/kg	500 mg/kg	ADEC Non-UST Action Level	150 cy	• microbial activity • oxygen diffusion • contaminant • concentration • solubility • volume • grain size • seasonal impact
	GRPH	ND - 700 mg/kg	100 mg/kg	ADEC Non-UST Action Level		
	RRPH	ND - 27,000 mg/kg	2,000 mg/kg	ADEC Non-UST Action Level		
	Benzene	ND - 1.4 mg/kg	0.5 mg/kg	ADEC Non-UST Action Level		
Area Underneath Bldg.	DRPH	3,100 - 5,800 mg/kg	500 mg/kg	ADEC Non-UST Action Level	110 cy	• accessibility • contaminant • concentration • solubility • drainage
	GRPH	190 mg/kg (only one sample)	100 mg/kg	ADEC Non-UST Action Level		
	RRPH	ND - 2,300 mg/kg	2,000 mg/kg	ADEC Non-UST Action Level		

[a] Target cleanup levels for DRPH, GRPH, and RRPH in soil are based on ADEC Non UST guidance and do not necessarily correspond to final site specific cleanup goals.

TABLE 6-5. REMEDIAL ACTION CHARACTERIZATION FOR THE WHITE ALICE FACILITY (SS16)

MEDIA	CONTAMINANTS	RANGE OF ENVIRONMENTAL CONTAMINATION	TARGET CLEANUP LEVEL[a]	BASIS FOR LISTING AS COC	VOLUME OF CONTAMINATED MEDIA	DESIGN PARAMETERS
Gravel	Aroclor 1254	ND - 52 mg/kg	0.54 mg/kg	TSCA Cleanup Level and Risk $>10^{-6}$	2 cy	none, the presumptive remedy excavation and offsite treatment will be conducted
Note: Target assumes high frequency of exposure in commercial and residential setting. Target is 25 mg/kg where frequency of exposure is minimal or where access is restricted.						

[a] Target cleanup levels for DRPH, GRPH, and RRPH in soil are based on ADEC Non UST guidance and do not necessarily correspond to final site specific cleanup goals.

6.1.1 Summary of Site Information

The information considered for each site includes:

- medium;
- COCs;
- range of chemicals detected;
- target cleanup level (or proposed remediation goal - the lowest applicable action level, based on the Risk Assessment including cancer risk, noncancer hazard quotient, and chemical-specific ARARs);
- basis for the target cleanup level (specific ARAR, cancer risk or noncancer hazard quotient); and
- design parameters for remedial action.

6.1.2 Estimated Areas, Volumes, and Masses of Contaminated Media

The approximate areas, volumes, and mass of the contaminated media are presented in Table 6-6 for use in the medium-specific rather than site-specific approach discussed in the introduction. Areas and depths are estimated based on the RI, and the density is estimated to be 1.8 tons/cubic yard. The locations and estimated volumes of contaminated media are illustrated in Figure 6-1. The media include gravel, areas beneath the two buildings, and tundra. Total volumes of media are:

- gravel - approximately 205 cubic yards;
- areas underneath buildings - approximately 220 cubic yards; and
- tundra - approximately 2,732 cubic yards.

GRAs and remedial alternatives are screened and evaluated for these three media.

Estimates of cost and project duration are provided in Attachments A and B, respectively. These attachments are located at the end of Section 6.0.

6.1.3 ARARs

Under the NCP, ARARs must be identified and evaluated to determine all of the requirements for remedial actions. There are three categories of ARARs:

- Chemical-specific;
- Action-specific; and
- Location-specific.

Chemical-specific ARARs are action levels that may apply in addition to risk or hazard-based remediation goals. Chemical-specific ARARs were identified during the RI and included in the Risk Assessment. The target cleanup levels or proposed remediation goals represent the lowest applicable action level.

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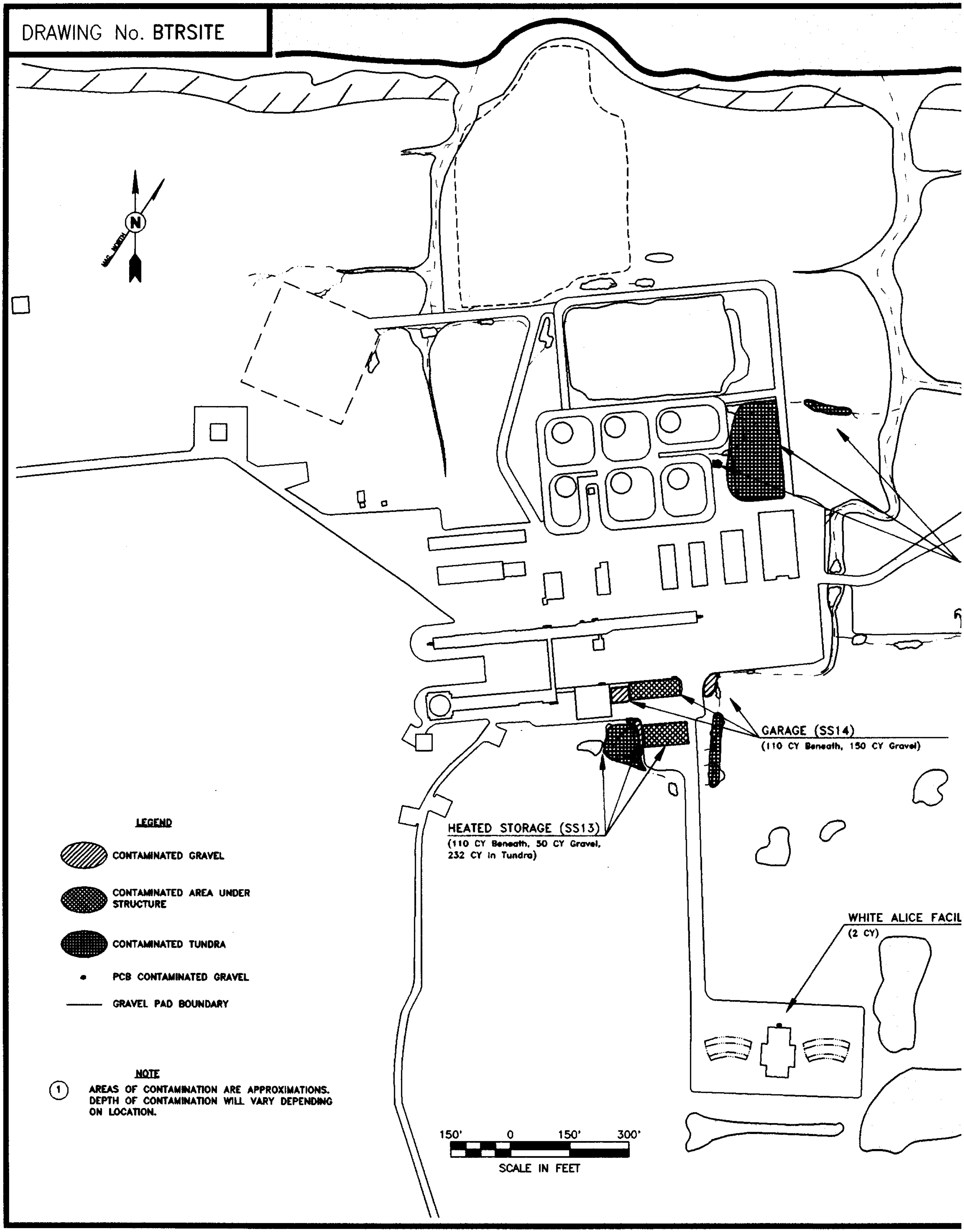

DRAWING No. BTRSITE
N
MAG. NORTH
GARAGE (SS14)
(110 CY Beneath, 150 CY Gravel)
HEATED STORAGE (SS13)
(110 CY Beneath, 50 CY Gravel, 232 CY in Tundra)
WHITE ALICE FACIL
(2 CY)
LEGEND
CONTAMINATED GRAVEL
CONTAMINATED AREA UNDER STRUCTURE
CONTAMINATED TUNDRA
PCB CONTAMINATED GRAVEL
GRAVEL PAD BOUNDARY
NOTE
1 AREAS OF CONTAMINATION ARE APPROXIMATIONS. DEPTH OF CONTAMINATION WILL VARY DEPENDING ON LOCATION.
150' 0 150' 300'
SCALE IN FEET

(2)

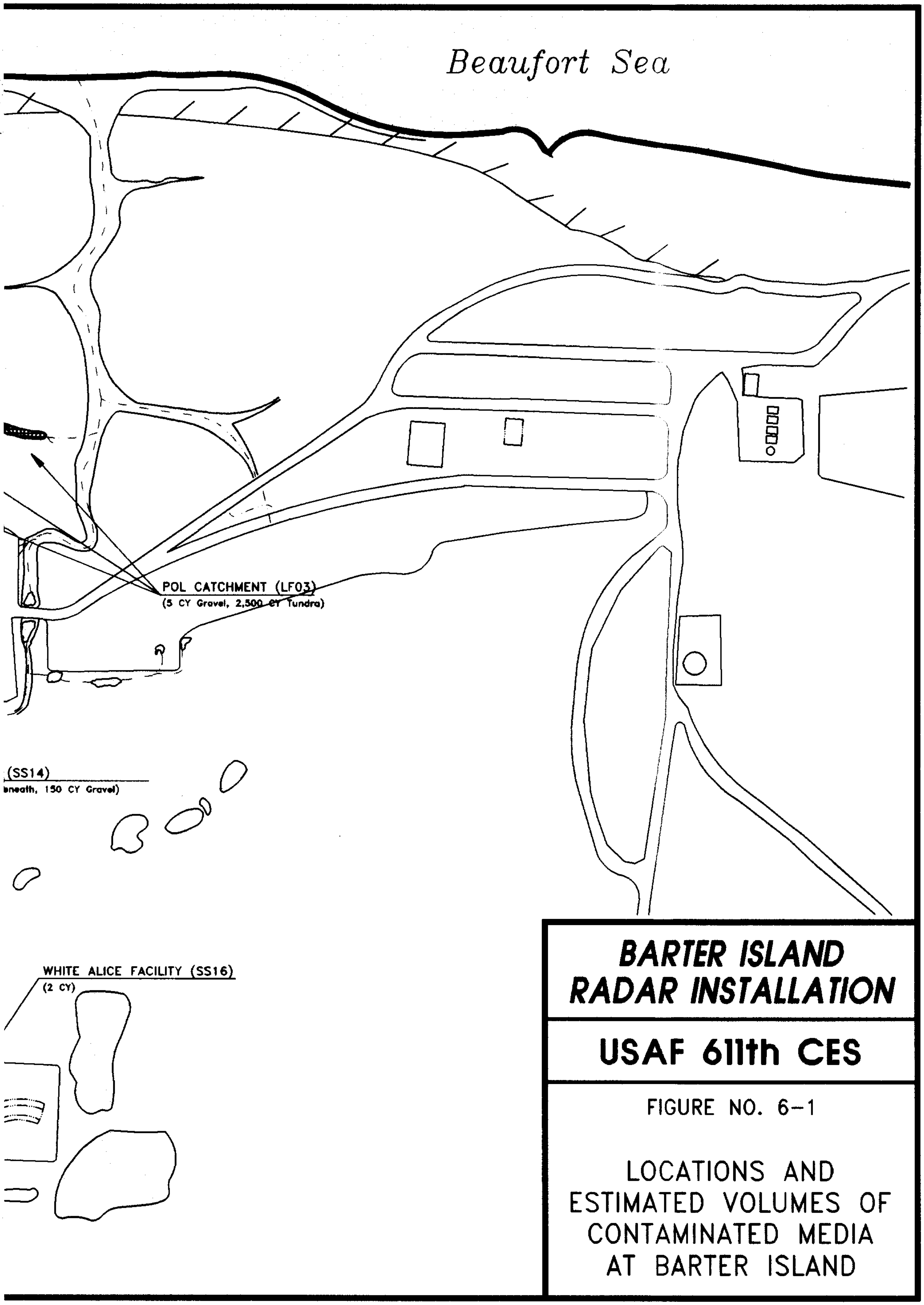

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FIGURE NO. 6-1

LOCATIONS AND ESTIMATED VOLUMES OF CONTAMINATED MEDIA AT BARTER ISLAND

TABLE 6-6. APPROXIMATE AREAS, VOLUMES AND MASSES OF CONTAMINATED MEDIA BY SITE AT BARTER ISLAND

SITE	MEDIUM	AREA (sq ft)	DEPTH (ft)	VOLUME (cy)	MASS (tons)
POL Catchment (LF03)	gravel	36	4	5	9
POL Catchment (LF03)	tundra	27,000	2.5	2,500	4,500
Heated Storage (SS13)	gravel	340	4	50	90
Heated Storage (SS13)	soil underneath building	3,000	1	110	198
Heated Storage (SS13)	tundra	2,500	2.5	232	418
Garage (SS14)	gravel	1,008	4	150	270
Garage (SS14)	soil underneath building	3,000	1	110	198
White Alice Facility (SS16)	gravel	16	4	2	3.6

Action-specific ARARs are requirements that relate to how remedial actions must be conducted. For example, offsite transport of hazardous waste must be manifested in compliance with the RCRA.

Location-specific ARARs impose requirements on a remedial action based on the location of the site. For example, there are specific requirements that pertain to wetlands.

It should be noted that ADEC's Non-UST contaminated soil target cleanup levels are intended as guidance and do not necessarily correspond to final site specific cleanup levels. The ARARs for the sites at the Barter Island installation are presented in Table 6-7.

6.2 SCREENING OF GENERAL RESPONSE ACTIONS

6.2.1 Presentation and Screening of General Response Actions

GRAs are general approaches for remedial actions and can be active or passive measures. Active measures involve removal, active treatment, or isolation of the contaminated media. Passive measures rely on natural processes to reduce the toxicity, mobility, or volume of contamination, or on controls put in place to limit exposure. GRAs apply to contaminants in all of the environmental media separately, or in any combination. Screening GRAs streamlines the FS process by establishing the feasibility of entire classes of remedial responses, thereby enabling the selection of a focused set of viable alternatives for detailed evaluation. GRAs have been evaluated for the media contaminated at the POL Catchment (LF03), Heated Storage (SS13), and Garage (SS14). It is most likely that any remedial action at Barter Island would be

TABLE 6-7. ARARs FOR SITES AT THE BARTER ISLAND INSTALLATION

AUTHORITY	CITATION	TYPE OF ARAR	BASIS	CATEGORY OF ARAR
Clean Air Act	42 U.S.C. 7401-7642, 40 CFR 60, 61, and 63	Action-specific	National Ambient Air Quality Standards (Treatment technology standards for fugitive emissions and landfills)	Applicable
ADEC, Interim Guidance for Non-UST Action Levels	18 AAC 75.140	Chemical-specific	Standards for general guidance	Relevant and Appropriate
RCRA	40 CFR Part 263	Action-specific	Standards Applicable to Generators of Hazardous Waste	Relevant and Appropriate
RCRA	40 CFR 268.35	Action-specific	Land Disposal Restrictions Waste specific prohibitions third-third wastes	Relevant and Appropriate
ADEC, Interim Guidance for Surface and Groundwater Cleanup Levels	AS 46.03.070, AS 46.09.020, 18 AAC 70.020 (b), AS 46.04.020, 18 AAC 75.140, 18 AAC 70.025, 18 AAC 70.030 18 AAC 70.010, and 18 AAC 70.040	Location-specific	Standards applicable for water used for drinking and surface water important to the growth and propagation of aquatic life	Relevant and Appropriate
RCRA	40 CFR Part 263	Action-specific	Standards Applicable to Generators of Hazardous Waste	Relevant and Appropriate
RCRA	40 CFR 268.35	Action-specific	Land Disposal Restrictions Waste specific prohibitions third-third wastes	Relevant and Appropriate
Toxic Substances Control Act	40 CFR 761.60(a)(4)	Action-specific	Disposal Requirements	Applicable
RCRA	40 CFR 268.35	Action-specific	Land Disposal Restrictions Waste specific prohibitions third-third wastes	Relevant and Appropriate
RCRA	40 CFR Part 263	Action-specific	Standards Applicable to Generators of Hazardous Waste	Relevant and Appropriate
OSWER Solid Lead Cleanup Guidance	Updates on OSWER Solid Lead Cleanup Guidance, August 29, 1991 (EPA 1991b)	Location-specific	Standard applicable for concentration of lead in soil	Relevant and Appropriate

TABLE 6-7. ARARs FOR SITES AT THE BARTER ISLAND INSTALLATION (CONTINUED)

AUTHORITY	CITATION	TYPE OF ARAR	BASIS	CATEGORY OF ARAR
ADEC, Interim Guidance for Surface and Groundwater Cleanup Levels	AS 46.03.070 AS 46.09.020 AS 46.04.020 18 AAC 70.020 18 AAC 75.140	Chemical-specific	Standards applicable for water used for drinking and surface water important to the growth and propagation of aquatic life	Relevant and Appropriate
RCRA	40 CFR Part 263	Action-specific	Standards Applicable to Generators of Hazardous Waste	Relevant and Appropriate
SDWA	52 FR 25690 56 FR 3526	Chemical-specific	Maximum Contaminant Level for drinking water	Relevant and Appropriate
RCRA	55 FR 30798	Chemical-specific	Standard for Solid Waste Management Units, SWMUs, in the RCRA Corrective Action Program	Relevant and Appropriate
RCRA	40 CFR 268.35	Action-specific	Land Disposal Restrictions Waste specific prohibitions third-third wastes	Relevant and Appropriate

focused on the individual media rather than the sites. For example, alternatives for all of the gravel pad areas are more likely to be undertaken than those for sites with small volumes of tundra and gravel pad. The screening of GRAs, therefore, is based on a medium-specific approach. The development and evaluation of remedial alternatives will follow suit.

The criteria for screening GRAs are implementability, duration, and cost. Implementability is estimated in terms of technical and administrative barriers. For example, containment is generally less acceptable to regulatory agencies than removal or treatment. An innovative technology that has proven to be effective in the continental U.S. may not be implementable on the North Slope because it cannot be transported there.

Duration is the estimate of the time necessary to attain the treatment efficiency estimated from applicable case studies and the literature. The estimated duration of no action that includes natural, unassisted biodegradation is long even though the time necessary to implement no action is short.

Cost is the estimated capital, operating, and administrative costs necessary to attain the projected treatment efficiency. This estimate is presented in relative terms (low, medium, and high).

The GRAs considered for the sites at Barter Island are:

- No action;
- Institutional controls and monitoring;
- Containment; and
- Onsite treatment.

These GRAs are defined as follows.

No Action

Under no action contaminants are left in place, and only natural processes, such as biodegradation, would lower the concentrations of COCs. No action is considered for all three media.

Institutional Controls and Monitoring

Institutional controls and monitoring represent a passive response in which steps are taken to minimize the possibility of accidental exposure of humans and the environment to contaminants. Institutional controls may include fencing off an area to minimize exposure and public education to show people how to avoid exposure. Institutional control of sites contaminated by petroleum hydrocarbons minimizes the chance of accidental exposure while natural, unassisted biodegradation occurs. Monitoring is included to determine if migration of contaminants is occurring and if natural processes are lowering the concentrations of the COCs.

Containment

Containment limits the potential for accidental exposure to contaminants by physical means. Examples include capping soils and using solidification techniques (i.e., the maintenance of freezing conditions). The objectives are: 1) to minimize the risk of direct exposure to contaminated soils; 2) to eliminate the possibility of contaminants or contaminated soils migrating or becoming airborne; and 3) to prevent water from entering the contaminated area and transporting contaminants to other areas.

Onsite Treatment

Treatment may be used to reduce the toxicity, mobility, or volume of a contaminant and may be accomplished in situ or ex situ. In situ treatment involves active treatment with the medium in place. Ex situ treatment involves the removal of the contaminated medium, with subsequent treatment on the installation. The medium may be replaced in the original excavation after treatment or, as in the case of successful land spreading, be left where treatment took place. Treatment efficiencies vary depending on the technique used and the type of contaminant present. These efficiencies, presented in Section 6.4.1, are normally 85 to 95 percent.

Representative technologies for the GRAs retained are presented and screened in Section 6.2.2. GRAs considered for remediation of gravel, tundra, and the soil beneath the garage at the four sites recommended for remediation at Barter Island are presented in Table 6-8.

6.2.2 Presentation of Technologies

This section describes remedial technologies considered for use at Barter Island. GRAs retained in Section 6.2.1 that represent technologies proven effective in the Alaskan environment were selected. The conditions present at Barter Island, principally the arctic climate and remote location, exclude many technologies that could be considered for sites in a more temperate and accessible location.

The remedial technologies under consideration for the contaminated media at Barter Island are presented in this section by GRA as follows:

<u>No Action</u>

- No action

<u>Institutional Controls and Monitoring</u>

- Periodic monitoring
- Public education
- Fencing

TABLE 6-8. SCREENING OF GENERAL RESPONSE ACTIONS FOR REMEDIATION OF SITES AT BARTER ISLAND

GENERAL RESPONSE ACTION	REPRESENTATIVE TECHNOLOGIES	PROJECTED TREATMENT EFFICIENCY	RETAINED OR REJECTED	RATIONALE
No Action	• No Action	50 percent	Retained	Implementability: Moderate Duration: Long Effectiveness: Low to Moderate Cost: Low Retained/Rejected: Retained (requirement of NCP).
Institutional Controls and Monitoring	• Periodic Monitoring • Public Education • Fencing	50 percent	Retained	Implementability: High Duration: Long Effectiveness: Low to Moderate Cost: Low Retained/Rejected: Retained due to high implementability and low cost. The amount of nutrients in gravel may be too low for biodegradation.
Containment	• Maintenance of freezing conditions	90 percent reduction in mobility	Retained	Implementability: High Duration: Long Effectiveness: High Cost: Low to Moderate Retained/Rejected: Retained due to high implementability, effectiveness, and low cost.
Treatment	• Passive Bioremediation • Landspreading • Biosurfactants	75 - 90 percent	Retained	Implementability: High Duration: Short to Moderate Effectiveness: Moderate to High Cost: Moderate Retained/Rejected: Retained due to high implementability, moderate to high effectiveness, and short to moderate duration.
Removal	• Excavation and offsite treatment	100 percent	Rejected	Implementability: High Duration: Short Effectiveness: High Cost: High Retained/Rejected: Rejected due to high cost.

Containment

- Maintenance of freezing conditions

Onsite Treatment

- Passive bioremediation
- Landspreading
- Biosurfactants

All of the technologies presented above have been applied effectively at sites on the North Slope or elsewhere in Alaska. In addition to being effective in cold climates, they are well-suited to the short summer season (the only favorable time for outdoor remedial activities) and the remote location where there is little or no staffing for year-round operation and maintenance of remedial systems. Specifically, these remedial technologies are either short-term actions that can be completed in one season (approximately 100 days) with imported labor, or longer term actions that are self-sustaining and require minimal labor.

Several of the remedial technologies involve bioremediation, which may be accomplished on the North Slope with psychrophilic (i.e., cold weather) microorganisms both indigenous and imported.

Bioremediation has been documented on the North Slope and elsewhere in Alaska, but is subject to several limiting factors including:

- Availability of nutrients and oxygen;
- Short periods of thaw; and
- Percentage of fine-grained materials.

Biodegradation generally can be estimated in terms of first order kinetics, where the only rate limiting factor is the biodegradation potential, which is a function of the factors listed above. With first order kinetics, a given target cleanup level will eventually be reached regardless of the initial concentration; however, as the gap between initial and target concentrations widens or rate limiting factors become more significant, the time necessary to reach the target increases exponentially because the function plots asymptotically with concentration. A more detailed discussion of the estimates of passive biodegradation is presented in Section 6.4.

Descriptions of the technologies that have been retained are presented in the following subsections.

6.2.2.1 No Action. Required alternative.

6.2.2.2 Institutional Controls and Monitoring. This technology involves no active treatment, but takes advantage of natural, unassisted biodegradation that occurs in the arctic soil (Atlas 1985). Natural, unassisted bioremediation typically takes longer than assisted bioremediation. The rate of biodegradation, especially in the North Slope region, is reduced because of short warm seasons and prolonged harsh winters. Public education and fencing off

the affected area would constitute institutional controls, and monitoring would include sampling and analysis of any associated surface water and soil/sediment.

Institutional controls and monitoring are being evaluated for petroleum-related contaminants in gravel, tundra, and soils beneath structures. The case studies used to support biodegradation-based alternatives are used to estimate potential rates of natural, unassisted bioremediation.

6.2.2.3 Containment. The contaminated soil beneath the Heated Storage (SS13) and the Garage (SS14) represents a difficult remedial problem because the Air Force does not intend to raze the structures at this time. The vertical access is insufficient to manually remove the contaminated soil or to use equipment to do so. Attempts to flush the contamination introduce issues related to the control of runoff and the potential loss of structural integrity of the piles on which the Heated Storage and Garage rest due to melting of permafrost. The latter may not be the primary concern because the piles are set very deeply. One solution is to maintain freezing conditions under the buildings year round to keep contaminants locked in ice or frozen ground. The underside of the Heated Storage and the Garage are relatively cold year round because they remain shaded during the summer. Examples of cold containment include insulation with gravel cover and heat exchangers (or a combination of the two). Once the building is dismantled, the contaminated soil can be excavated and managed appropriately.

6.2.2.4 Passive Bioremediation. Passive bioremediation in this FS involves delivering water and nutrients to the contaminated soils in place to assist natural bioremediation. Several organisms that can utilize the carbon in petroleum are indigenous to the North Slope, including: *Bacillus cereus, Bacillus polymixa, Arthrobacter globiformis*, and *Alcaligenes poradoxus* (Ratliff 1993). In addition, several strains of *Pseudomonas* bacteria (psychrophilic genera) decreased TPH concentration in tundra during the summer season in the Prudhoe Bay area (Jorgenson et al. 1992). A case study conducted at Point Thompson, Alaska, suggests that this approach is feasible for remediation of gravel pads if a cultured population of microbes is used (Liddell 1991). The cultured population could be either indigenous or exotic. A treatability study will be necessary to determine how best to bioremediate each of the three media.

Variations in temperature affect the rate of biodegradation by bacteria. In the arctic environment, bacteria remain active enough to consume petroleum hydrocarbon molecules from June through August when average temperatures fluctuate between 33.8 and 42.8°F. Successful biodegradation of petroleum hydrocarbon contaminants in soil by indigenous bacteria is possible at the arctic summer ambient temperatures (Jacobson et al. 1982). Another study at Surfcote Pad in the Prudhoe Bay area (Evans, Elder, and Hoffman 1992) indicates that native microbial populations were capable of bioremediating diesel contaminated gravel at an appreciable rate during the short summer season. In the arctic environment at a depth of three feet microbial populations can effectively consume hydrocarbon products (Atlas 1985); however, the number and activity of bacteria decrease with depth because of reduced levels of oxygen and nutrients.

Passive bioremediation is being evaluated for gravel, the soil underneath the buildings, and tundra. Warm water with nutrients could be applied to contaminated areas under the Heated Storage (SS13) and the Garage (SS14) to provide conditions necessary for bioremediation. In

the tundra and gravel, water does not need to be warmed because heat is provided by the sun. Water would be added intermittently, if required, in quantities sufficient to keep the media moist.

It is anticipated that this process would not generate runoff. Nonetheless, a wastewater discharge permit or solid waste disposal permit may be required.for this process and precautions will be taken to contain any runoff that occurs. It is not expected that contaminants would be mobilized by this process, but any collected runoff would be analyzed to confirm this.

6.2.2.5 Biosurfactants. Biosurfactants have been used to remove hydrocarbons from contaminated soils and gravels. Biosurfactants are products of bacterial fermentation and may include sugars, fats, and proteins. They act by attaching to, and surrounding, hydrocarbon molecules thus detaching them from soil particles. Biosurfactants do not alter the structure of the hydrocarbons, but render them temporarily inert, preventing them from reattaching to soil particles and allowing their removal from soils by flushing with water. The flush water mixture is then collected and the biosurfactant-hydrocarbon mixture, which floats on water, is removed by skimming. The collected mixture of water and petroleum hydrocarbons could be bioremediated onsite in an aerated tank spiked with nutrients. Figure 6-2 is a diagram of the process.

This technology is being evaluated for treating DRPH, GRPH, and RRPH at the Heated Storage (SS13) and Garage (SS14) sites. It is readily available in Alaska and involves using high intensity "air knives" to jet the biosurfactant into the material being remediated. It is anticipated from the results of the site investigations that contamination beneath the structures is shallow (less than two feet) because permafrost close to the surface prevents the hydrocarbons from infiltrating deeply.

The "air knives" can probably penetrate far enough to mobilize all of the contamination. After the biosurfactant is applied, the medium will be flushed with water to remove the mix of hydrocarbons and surfactant. The flush water mixture will be collected from drainage pathways exiting areas beneath the Heated Storage (SS13) and the Garage (SS14). Collected water could be recirculated to minimize volume. Upon completion, collected water (500 - 1,000 gallons) could be evaporated, bioremediated, and/or treated with carbon adsorption units. Performance may not match case histories involving fairly fresh crude oil on rock surfaces, but it is anticipated that the mobile fraction of the weathered petroleum will be dislodged sufficiently for successful remediation. Because of the uncertainty associated with this new application of biosurfactants, a treatability test is included in the cost estimate. In addition, the estimated efficiency of this technology has been reduced in an effort to account for the uncertainty from 97 to 90 percent. Treatability testing could be conducted on a limited area directly below a floor drain, and would only be required at one of several DEW Line garage sites.

6.2.2.6 Landspreading. The objective of landspreading is to increase the surface area to volume ratio of soils contaminated with petroleum hydrocarbons to allow the low molecular weight fraction to volatilize more quickly, and to enhance biodegradation by exposing more of the soil to air, and wetting it to ensure ample moisture. Target COCs are DRPH, GRPH, RRPH, and benzene.

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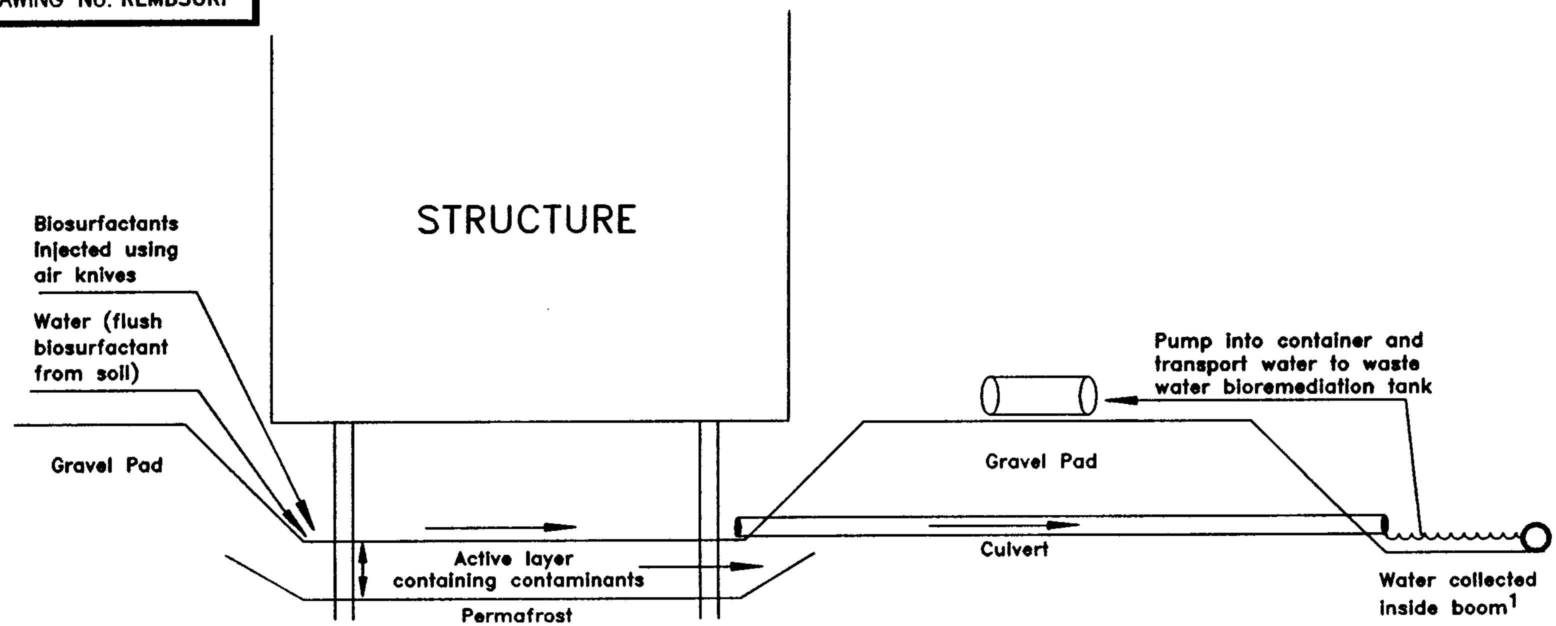
DRAWING No. REMBSURF



NOTES

This process should begin before general site remediation so that water treated from this process can be used as process water for either soil washing or ex-situ bioremediation.

1. Booms and other collection materials will be tested and disposed of offsite.

BARTER ISLAND RADAR INSTALLATION	FIGURE NO. 6-2 IN SITU USE OF BIOSURFACTANTS PROCESS FLOW DIAGRAM
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Landspreading is being evaluated for the gravel at the POL Catchment (LF03), the Heated Storage (SS13), and the Garage (SS14). The process is straightforward. A backhoe or other earth-moving equipment is used to excavate the contaminated gravel and spread it in two-inch layers on clean gravel. It is important to note that the gravel will not be spread on tundra. Moisture will be added during spreading to promote biodegradation. ADEC regulates this activity under a solid waste disposal permit if the petroleum hydrocarbon contamination exceeds 1,000 mg/kg. The requirement for a solid waste disposal permit will need to be evaluated on a site-by-site basis. Approximately one-half acre will be necessary to landspread the contaminated gravel. There is ample room at the installation to landspread the estimated volume of contaminated gravel.

6.3 DEVELOPMENT OF REMEDIAL ALTERNATIVES

6.3.1 Approach to Developing Remedial Alternatives

The remedial technologies selected in Section 6.2.2 represent the GRAs retained in Section 6.2.1. In this section the remedial technologies are developed into alternatives designed to address site-specific COCs. Alternatives developed in this section are evaluated in the Detailed Evaluation of Remedial Alternatives, Section 6.4.

This section is organized by remedial alternative. The rationale for development and a list of applicable sites are included. At the end of the section is a summary table of remedial alternatives.

The remedial alternatives are:

Gravel

- No action;
- Institutional controls and monitoring;
- Passive bioremediation;
- Landspreading; and
- Ex situ bioremediation.

Tundra

- No action;
- Institutional controls and monitoring; and
- Passive bioremediation.

Soil Beneath the Heated Storage (SS13) and the Garage (SS14)

- No action;
- Institutional controls and monitoring;
- Containment;

- Passive bioremediation; and
- Biosurfactants.

6.3.1.1 No Action.

Rationale for Development. No action provides a baseline against which other alternatives are compared, and it is a required alternative according to the NCP. Natural, unassisted biodegradation of petroleum hydrocarbons may occur over a long period of time if microbial populations and aerobic conditions (e.g., water, oxygen, temperature, and nutrients) are present. Natural, unassisted biodegradation is more likely to occur in the tundra, and less likely to be effective in gravel and soil beneath the Heated Storage (SS13) and the Garage (SS14).

Applicable Media and Sites.

- Gravel and tundra associated with the POL Catchment (LF03);
- Gravel, tundra, and soil beneath the structure associated with the Heated Storage (SS13); and
- Gravel and soil beneath the structure associated with the Garage (SS14).

6.3.1.2 Institutional Controls and Monitoring.

Rationale for Development. This limited action alternative is applicable to all of the media because the COCs do not pose a significant risk or HQ above threshold levels. Although, some risks and hazards exceed threshold levels, they were calculated conservatively based on a future scenario and are probably overestimated in the risk assessment (U.S. Air Force 1996). Natural, unassisted biodegradation of petroleum hydrocarbons may occur over a long period of time if microbial populations and aerobic conditions (e.g., water, oxygen, temperature, and nutrients) are present. Natural, unassisted biodegradation is more likely to occur in the tundra, and less likely to be effective in gravel and soil beneath the Heated Storage (SS13) and the Garage (SS14).

Institutional controls considered include public education and fencing off the affected area. Monitoring would be conducted periodically for two years to ensure that contaminants are biodegrading and are not migrating offsite. Monitoring data would be combined with the predicted degradation rate presented in this section to demonstrate the effectiveness of natural, unassisted biodegradation.

Applicable Media and Sites.

- Gravel and tundra associated with the POL Catchment (LF03);
- Gravel, tundra, and soil beneath the structure associated with the Heated Storage (SS13); and
- Gravel and soil beneath the structure associated with the Garage (SS14).

6.3.1.3 Containment.

Rationale for Development. The soil beneath the Heated Storage (SS13) and the Garage (SS14) poses several technical problems because the Air Force has no immediate plans to dismantle the buildings. Vertical access is limited; therefore, conventional excavation is infeasible. Flushing requires runoff control and capture and may affect the stability of the structure. Containment by maintenance of freezing conditions could be an effective way to prevent the migration of contaminants until the building is dismantled or a highly effective remedial technology becomes available. Human exposure would be very limited because of the low vertical clearance. Several methods exist for maintaining freezing conditions beneath buildings in Alaska. Methods include insulation, heat exchangers, or a combination of the two.

Applicable Media and Sites.

- Soil Beneath the Heated Storage (SS13) and
- Soil Beneath the Garage (SS14).

6.3.1.4 Passive Bioremediation.

Rationale for Development. This is a low maintenance method for reducing petroleum concentrations in tundra that is also applicable to the gravel pad and the soil beneath the buildings. Passive bioremediation in this FS is assisted bioremediation (i.e., lime-enhanced bioremediation). The assistance is low level, and includes the addition of appropriate amounts of nutrients, lime, and moisture, and the assumption that sufficient oxygen is present to support aerobic metabolism of hydrocarbons. This alternative is more aggressive than natural, unassisted attenuation, yet can be designed to limit disturbance of the tundra and permafrost. A treatability study will be necessary to demonstrate site-specific viability of this alternative. For example, the percentage of fine-grained soils in the gravel will affect the soils ability to retain moisture and organic carbon.

Monitoring for two years will verify the progress of the process.

Applicable Media and Sites.

- Gravel and tundra associated with the POL Catchment (LF03);
- Gravel, tundra, and soil beneath the structure associated with the Heated Storage (SS13); and
- Gravel and soil beneath the structure associated with the Garage (SS14).

6.3.1.5 Biosurfactants.

Rationale for Development. Biosurfactants were proven effective in removing petroleum hydrocarbons from shallow soils, hard surfaces, and rocks following the Valdez oil spill. It is applicable to the soil beneath the Heated Storage (SS13) and the Garage (SS14). Biosurfactants are not recommended for the gravel or tundra. The application of biosurfactants to soils beneath

buildings carries significant uncertainly; therefore, a treatability study will be conducted to determine the viability of this approach.

Monitoring will verify the effectiveness of the remedial action.

Applicable Media and Sites

- Soil Beneath the Heated Storage (SS13)
- Soil Beneath the Garage (SS14).

6.3.1.6 Landspreading.

Rationale for Development. Landspreading is a recognized method for remediating petroleum hydrocarbons in gravel in Alaska. There are established regulations for the approach and ample space to spread the estimated volume of contaminated gravel in two-inch lifts on clean gravel sufficiently far away from surface water. Landspreading is not appropriate for either the tundra or the soil beneath the Heated Storage (SS13) and the Garage (SS14).

Monitoring for two years will establish the effectiveness of this alternative.

Applicable Media and Sites for Landscaping (Gravel)

- Gravel associated with POL Catchment (LF03);
- Gravel associated with the Heated Storage (SS13); and
- Gravel associated with the Garage (SS14).

6.4 DETAILED EVALUATION OF REMEDIAL ALTERNATIVES

6.4.1 Approach

The alternatives developed in Section 6.3 are evaluated in this section using the suggested criteria in the AFCEE guidance for remedial alternative evaluation. These five criteria are defined in Sections 6.4.1.1 through 6.4.1.5. The detailed evaluation of alternatives is conducted in Section 6.4.2 and summarized in Section 6.4.3. The alternatives are evaluated with respect to the NCP's nine criteria in Section 6.4.4. Preferred alternatives are presented in Section 6.4.5.

6.4.1.1 Successful Application Of The Technology Under Site Conditions. This criterion requires the location and approximate date of the applications and the managing entity, and a presentation of successful applications of the given alternative under conditions similar to those found at the Barter Island installation. Case studies conducted on the Alaskan North Slope are used to the extent possible, with due consideration to the uncertainties associated with remedial technologies in this environmental setting, and to the differences in the remedial potential between weathered refined product and fresh crude. Many of the case studies are based on fresh crude.

6.4.1.2 Total Project Cost. The total cost of performing the remedial alternative is estimated and divided into technology testing, capital, total labor, operating, environmental testing, closure, and indirect costs.

For the purpose of this evaluation, the itemized cost elements are defined as follows:

- Technology testing costs consist of pilot tests or treatability studies;
- Capital costs include equipment or materials purchased;
- Total labor costs include the labor required for operating and maintaining the remedial action system, oversight, project management, design and development of planning documents;
- Operating costs include costs other than labor associated with operating remedial systems (e.g., in situ use of biosurfactants) and earth moving;
- Environmental testing costs are for sampling and analysis, including annual monitoring, and monitoring associated with site closure; and
- Closure costs are those related to reporting associated with site closure.

6.4.1.3 Contaminant Reduction. The reduction in concentration of each COC may be projected for each medium and site based on case-study derived efficiencies. This reduction, referred to as post-remedial concentration, is listed with the initial concentration and target cleanup level. Post-remedial concentration is a more useful measure of effectiveness than risk reduction for the remedial alternatives at the Barter Island installation. None of the COCs, except for Aroclor 1254 at the White Alice Facility (SS16), is included because of cancer risk or noncancer HQ. Risks or HQs, therefore, are not the indicators of successful remediation. Post-remedial concentration is applicable to target cleanup concentrations set by regulations and/or cleanup guidance.

The concentrations presented in Section 6.4.3 are defined as follows:

Initial Concentration. This is the average initial concentration of the COC detected.

Target Cleanup Level. This is the cleanup level specified for the given COC (the basis for which is presented in Tables 6-2 through 6-5).

Post Remedial Concentration. This is the estimated final concentration of the COC based on remedial efficiencies from case studies. References to these case studies can be found in Section 6.4.2, Successful Applications of Alternatives. Estimated remedial efficiencies presented apply to all organic COCs for biosurfactants. For passive bioremediation, landspreading, institutional controls and monitoring, and no action, the estimated remedial efficiencies differ depending on the biodegradability of the particular COC. Specific estimated efficiencies used are presented below. The estimates are independent of time (over the short term, e.g., one year,

biodegradation would be significantly less efficient than active remedial alternatives like biosurfactants).

The following remedial efficiencies are used for all petroleum hydrocarbons compounds detected:

- Biosurfactants - 90 percent (case studies indicate a higher efficiency, but the unique application may result in a loss of efficiency) and

The following efficiencies are used for DRPH, GRPH, and benzene:

- Passive bioremediation - 94 percent;
- Landspreading - 75 percent; and
- Naturally occurring bioremediation
(Institutional controls and monitoring and no action) - 50 percent.

The following estimated efficiencies are used for RRPH:

- Passive bioremediation - 75 percent;
- Landspreading - 75 percent; and
- Naturally occurring bioremediation
(Institutional controls and monitoring and no action) - 50 percent.

Components of RRPH that would not biodegrade probably are higher molecular weight hydrocarbons that pose no risk or hazard to the environment or human health.

The post-remedial concentration is estimated using the following formula (assuming no time constraints):

Post-remedial Concentration = Initial Concentration x (1 - Remedial Efficiency)

6.4.1.4 Project Duration. The estimated duration of each remedial alternative and associated project schedule is an important consideration because of the seasonal limitations on outdoor work and the lack of personnel to perform operation and maintenance activities in this remote location. The North Slope of Alaska is frozen and covered with snow and ice for the majority of the year, leaving a period of only approximately 100 days in the summer when the weather is favorable for outdoor work. Outdoor phases of remedial actions significantly longer than 100 days must be suspended until the following summer, causing a marked increase in duration because of the extended winter down time. In order to maximize efficiency, remedial alternatives were designed to either complete outdoor phases of remediation within this narrow time frame (e.g., biosurfactants) or extend over a longer term and require only minimal labor (e.g., passive bioremediation, landspreading, and institutional controls and monitoring).

Project durations are based on case studies from Alaska. The rates of biological degradation for passive bioremediation, landspreading, and naturally occurring bioremediation associated with

institutional controls and monitoring are expressed as a first order decay function. The first-order decay function used to model this biological degradation is $C = C_0 e^{-kt}$ (C is final concentration, C_0 is the initial concentration, e is the natural logarithm, k is a constant based on case studies, and t is time).

The rate constant, k, is estimated based on related case studies. In general, the k-values presented reflect the lower end of the expected range of values and are downwardly adjusted because of the arctic environment conditions. The lowest rates are associated with no action and institutional controls and monitoring because there is no enhancement of conditions. The next lowest rate is associated with landspreading because adding moisture and oxygen are but two of several factors that can be optimized and the climate factor is unaffected. Passive bioremediation ranks highest because more factors are optimized than pH. DRPH is used to estimate the constants for all of the petroleum hydrocarbons because it represents by far the highest concentrations at all of the sites. The concentration of DRPH, therefore, is the controlling factor in determining the effectiveness of the remedial alternatives for these sites. The following constants and criteria were used for estimation of remedial rates:

<u>DRPH Reduction</u>

No Action or Institutional controls and monitoring $k = 0.0025$/day
(Natural, unassisted bioremediation)

The k-value for no action and institutional controls and monitoring is based on rate data from a control cell in an experiment to measure the effectiveness of enhanced bioremediation (Liddell 1991). The case study k-value was decreased in an attempt to affect the bias that aeration of the control cell introduces.

Landspreading $k = 0.005$/day

The decay control for landspreading is estimated to fall between a case study (Song et al. 1990) involving lime and nutrient addition and the control cell data cited above for natural unassisted biodegradation.

Passive bioremediation $k = 0.008$/day

This rate is based on the rates found from observing a number of case studies. It represents the low end of the range of decay constants observed because many of the case studies took place under climatic conditions more favorable than those which exist at Barter Island.

A comparison of the predicted degradation of DRPH using the bioremedial technologies being evaluated is illustrated in Figure 6-3.

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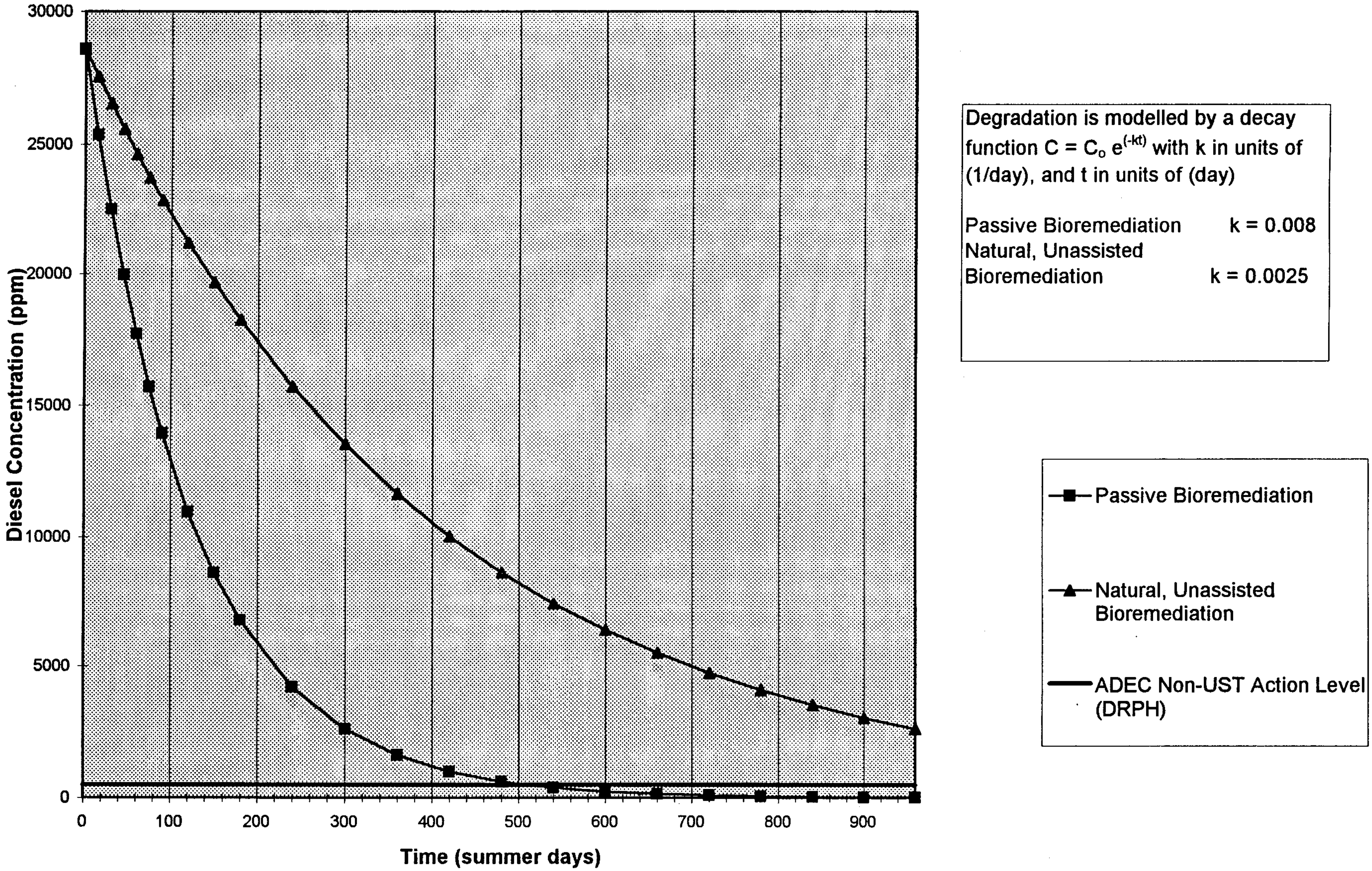
Figure 6-3. Comparative Biodegradation of Diesel Fuel in the Environment (Basis: Maximum Diesel Concentration of 28,600 at Barter Island)



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The duration of onsite remedial activity and the total project duration are presented in Attachment B. These durations are defined as follows:

- Duration of onsite remedial activity includes all onsite activities related to conducting the remedial action: sampling, operating remedial equipment, two years of remedial activity, mobilization, and demobilization (this is a quantification of the relative duration estimate). The predicted time for remediation to reach the target cleanup levels is provided in parentheses; and

- Total project duration includes the duration of onsite remedial activity, as well as time required for preparing planning documents, conducting permitting activities, and closure.

6.4.1.5 Data Gaps. Data gaps include any environmental testing or treatability studies that must be done to determine the effectiveness of a given remedial alternative under site conditions.

Alternatives are analyzed comparatively based on the AFCEE criteria above, and the nine criteria in the NCP. The preferred remedial alternatives are identified in Section 6.4.5.

6.4.2 Detailed Evaluation of Alternatives

This section presents a detailed evaluation of remedial alternatives for three of the four sites requiring remedial action at the Barter Island radar installation: POL Catchment (LF03), Heated Storage (SS13), and the Garage (SS14). The fourth site, the White Alice Facility (SS16), will be remediated by excavation and offsite transport of gravel contaminated by Aroclor 1254. Alternatives are developed by medium, i.e., gravel, tundra, and the soil beneath the buildings rather than by site. Table 6-9 summarizes the remedial alternatives evaluated in Sections 6.4.2.1 through 6.4.2.5.

6.4.2.1 Successful Applications of Alternatives.

For brevity, alternatives that apply to more than one medium are described only once.

No Action. As part of a study on in situ bioremediation of DRPH-contaminated gravel pads and soils near Prudhoe Bay, a control cell was left unassisted and untreated. This control cell represents, in essence, natural attenuation. Initial DRPH concentration was approximately 1,900 mg/kg. After nine weeks the DRPH concentration had decreased to 1,200 mg/kg. This indicates a reduction of 37 percent in DRPH concentration in 63 days. In addition, a slight increase in the microbial population was noted (Liddell et al. 1991). The difference between a control cell and undisturbed gravel is that the control cell material is oxygenated as it is placed in the cell. As a result, the rate and magnitude of reduction is probably greater than that for undisturbed soil or gravel.

Institutional Controls and Monitoring. The bioremediation study noted above applies to this remedial alternative.

TABLE 6-9. SUMMARY OF REMEDIAL ALTERNATIVES BY MEDIUM

MEDIUM	SITES	REMEDIAL ALTERNATIVES
Gravel	POL Catchment (LF03) Heated Storage (SS13) Garage (SS14)	• No action • Institutional controls and monitoring • Passive bioremediation • Landspreading
Tundra	POL Catchment (LF03) Heated Storage (SS13)	• No action • Institutional controls and monitoring • Passive bioremediation
Soil Beneath Building	Heated Storage (SS13) Garage (SS14)	• No action • Institutional controls and monitoring • Entrainment • Passive bioremediation • Biosurfactants

Containment. Although there are no examples of maintaining freezing conditions to contain contaminants on the North Slope, the method has been developed as an innovative technology in the lower 48 states, and the low maintenance approaches of insulation and heat exchangers are routinely used in Alaska to protect the integrity of stilted structures by keeping the level of permafrost at or near the ground surface.

Passive Bioremediation. Passive bioremediation (i.e., through nutrient, lime, and moisture addition) has been successfully implemented in the arctic environment to treat petroleum hydrocarbon contamination on the North Slope. Studies at Point Thompson and Kuparuk oil fields in Alaska show that passive bioremediation is a successful and efficient method for remediating and reducing the concentration of petroleum hydrocarbons to a desired level within a relatively short time. The Point Thompson case study shows that 16,000 cubic yards of TPH contaminated gravel with an initial concentration of 2,000 to 3,000 ppm was bioremediated to an average concentration of 285 ppm between July and September 1990 (Liddell et al. 1991).

The estimated remedial action efficiency of passive bioremediation is 94 percent based on case studies done in Alaska and estimates of biodegradation kinetics.

Landspreading. Landspreading is a recognized method for remediating petroleum hydrocarbons in gravel in Alaska. There are established regulations for the approach and ample space to spread the estimated volume of contaminated gravel in two-inch lifts on clean gravel sufficiently far away from surface water. Absorbent materials will be used around the perimeter to prevent runoff from the addition of moisture. Based on the estimated volume of gravel, less than an acre is needed. The area will be fenced with a silt fence to minimize the migration of fine particles from the area and to prevent exposure to visitors.

The estimated remedial efficiency for this approach is based on an assumption that it will fall between the efficiencies for passive bioremediation (with nutrients, lime, and moisture added) and

natural biodegradation because spreading increases aeration and moisture will be added, but no nutrients or pH adjustment is included.

Biosurfactants. Biosurfactants were used successfully in cleaning petroleum from rocks and underlying sands and soils in the Prince William Sound area in 1993 (Tesoro/PES 1993). They also were used successfully in cleaning hydrocarbon contamination from rocks and soils at a refinery in Kenai, Alaska, in 1992 (Tesoro/PES 1992). Specific North Slope case studies have not been identified, but the site conditions, especially the shallow permafrost beneath the structures and existing drainage, should allow for collection of any materials introduced by this process. A wastewater discharge permit may be required.

The estimated remedial action efficiency for the in situ use of biosurfactants is 90 percent, based on the reduction found in a case study done at the Tesoro Kenai Refinery (Tesoro/PES 1992) and consideration of the uncertainty in this application of the technology. This efficiency should be possible under conditions found on the North Slope; however, a treatability test will be conducted to determine site-specific efficiency.

6.4.2.2 Project Costs. A summary of project costs for the remedial alternatives is included in Tables 6-10 through 6-12 by medium. Detailed cost estimates for each remedial alternative are located in Attachment A.

6.4.2.3 Contaminant Reduction. The degree to which COCs will meet target cleanup levels (proposed remediation goals) for each alternative for all three media is summarized in Table 6-13. This measure is presented as post-remedial concentration, or the initial concentration of DRPH multiplied by one minus the projected efficiency. DRPH is selected because its concentration is so much greater than the other COCs that it will drive the selection of the remedial alternative.

6.4.2.4 Project Duration. A breakdown of the project durations for the remedial alternatives is shown in Tables 6-14 through 6-16. Detailed project duration tables for each of the alternatives are located in Attachment B. Several assumptions are made concerning passive bioremediation and landspreading based on case studies and best engineering judgement. Technology testing will be necessary for alternatives involving passive bioremediation and landspreading to determine their feasibility under site-specific conditions and to provide information for detailed design. Technology testing is expected to take about 60 days. This should not affect the start of the onsite remedial activities, provided that sufficient time is allowed for this to occur before other onsite activities begin.

6.4.2.5 Data Gaps. Data gaps are described organized by remedial alternative. Remedial alternatives that apply to more than one medium are described only once since the data gaps are independent of medium.

No Action. The data gaps are the lack of information on site-specific biodegradation potential.

Institutional Controls and Monitoring. The data gaps are the lack of information on site-specific biodegradation potential.

TABLE 6-10. SUMMARY OF PROJECT COSTS FOR REMEDIAL ACTION ALTERNATIVES FOR GRAVEL

REMEDIAL ALTERNATIVE	TECHNOLOGY TESTING	CAPITAL COST	TOTAL LABOR	OPERATING COST	ENVIRONMENTAL TESTING	CLOSURE COST	ADMINISTRATIVE AND OTHER INDIRECT COSTS	PRESENT VALUE
No Action	$0	$0	$0	$0	$0	$5,000	$750	$5,750
Institutional Controls and Monitoring	$0	$100	$29,320	$16,675	$1,560	$5,000	$14,075	$66,730
Passive Bioremediation	$7,500	$2,560	$74,505	$42,125	$2,330	$4,320	$42,220	$167,560
Landspreading	$7,500	$18,730	$92,690	$48,225	$2,330	$4,320	$44,245	$217,675

TABLE 6-11. SUMMARY OF PROJECT COSTS FOR REMEDIAL ACTION ALTERNATIVES FOR TUNDRA

REMEDIAL ALTERNATIVE	TECHNOLOGY TESTING	CAPITAL COST	TOTAL LABOR	OPERATING COST	ENVIRONMENTAL TESTING	CLOSURE COST	ADMINISTRATIVE AND OTHER INDIRECT COSTS	PRESENT VALUE
No Action	$0	$0	$0	$0	$0	$5,000	$750	$5,750
Institutional Controls and Monitoring	$0	$100	$29,320	$16,675	$1,040	$5,000	$13,865	$66,000
Passive Bioremediation	$7,500	$3,590	$74,505	$40,875	$1,550	$4,320	$33,955	$166,295

TABLE 6-12. SUMMARY OF PROJECT COSTS FOR REMEDIAL ACTION ALTERNATIVES FOR SOIL BENEATH THE HEATED STORAGE (SS13) AND GARAGE (SS14)

REMEDIAL ALTERNATIVE	TECHNOLOGY TESTING	CAPITAL COST	TOTAL LABOR	OPERATING COST	ENVIRONMENTAL TESTING	CLOSURE COST	ADMINISTRATIVE AND OTHER INDIRECT COSTS	PRESENT VALUE
No Action	$0	$0	$0	$0	$0	$5,000	$750	$5,750
Institutional Controls and Monitoring	$0	$100	$29,320	$16,675	$1,040	$5,000	$13,865	$66,000
Containment	$0	$36,000	$71,760	$30,000	$0	$0	$22,665	$158,425
Passive Bioremediation	$7,500	$2,570	$74,505	$40,875	$1,550	$4,320	$33,700	$165,020
Biosurfactants	$7,500	$10,540	$72,640	$39,825	$1,550	$6,480	$35,590	$174,125

TABLE 6-13. ESTIMATED POTENTIAL CONTAMINANT REDUCTION (ALL MEDIA)

ALTERNATIVE	MEDIUM	CONTAMINANTS	AVERAGE INITIAL CONCENTRATION OF DRPH* (mg/kg)	PRG CONCENTRATION FOR DRPH (mg/kg)	POST-REMEDIAL CONCENTRATION FOR DRPH (mg/kg)
No Action	Gravel	DRPH, GRPH, RRPH, Benzene	9,330	500	4,665
	Tundra	DRPH, RRPH	26,250	500	13,125
	Soil Beneath Garage	DRPH, GRPH, RRPH	4,690	500	2,345
Institutional Controls and Monitoring	Gravel	DRPH, GRPH, RRPH, Benzene	9,330	500	4,665
	Tundra	DRPH, RRPH	26,250	500	13,125
	Soil Beneath Garage	DRPH, GRPH, RRPH	4,690	500	2,345
Passive Bioremediation	Gravel	DRPH, GRPH, RRPH, Benzene	9,330	500	560
	Tundra	DRPH, RRPH	26,250	500	1,575
	Soil Beneath Garage	DRPH, GRPH, RRPH	4,690	500	281
Biosurfactants	Soil Beneath Garage	DRPH, GRPH, RRPH	4,690	500	469
Landspreading	Gravel	DRPH, GRPH, RRPH, Benzene	9,330	500	2,332
Containment	Soil Beneath Garage	DRPH, GRPH, RRPH	4,690	500	4,690[a]

* Weighted average of the maximum DRPH value at each applicable site and the estimated volume of the affected medium.
a Containment involves no treatment; therefore, the post-remedial concentration is unchanged. It is estimated to reduce contaminant mobility by 90 percent.

TABLE 6-14. ESTIMATED PROJECT DURATION FOR REMEDIAL ACTION ALTERNATIVES FOR GRAVEL

REMEDIAL ALTERNATIVE	DURATION OF ONSITE REMEDIAL ACTIVITY (Days)	TOTAL PROJECT DURATION (Days)
No Action	0	30
Institutional Controls and Monitoring	11	881
Passive Bioremediation	23	988
Landspreading	44	1,009

TABLE 6-15. ESTIMATED PROJECT DURATION FOR REMEDIAL ACTION ALTERNATIVES FOR TUNDRA

REMEDIAL ALTERNATIVE	DURATION OF ONSITE REMEDIAL ACTIVITY (Days)	TOTAL PROJECT DURATION (Days)
No Action	0	30
Institutional Controls and Monitoring	11	881
Passive Bioremediation	23	988

TABLE 6-16. ESTIMATED PROJECT DURATION FOR REMEDIAL ACTION ALTERNATIVES FOR SOIL BENEATH THE HEATED STORAGE (SS13) AND GARAGE (SS14)

REMEDIAL ALTERNATIVE	DURATION OF ONSITE REMEDIAL ACTIVITY (Days)	TOTAL PROJECT DURATION (Days)
No Action	0	30
Institutional Controls and Monitoring	11	881
Containment	22	119
Passive Bioremediation	23	988
Biosurfactants	23	988

Containment. The data gaps relate to design specifications including the most appropriate method for maintaining freezing conditions and the method for accessing the underside of the Heated Storage (SS13) and Garage (SS14).

Passive Bioremediation. The data gap is the lack of information on site-specific biodegradation potential. A treatability study will be necessary to determine the biodegradation potential of contaminants in each medium. Several parameters must be investigated, including pH and baseline microbial activity.

Biosurfactants. Effectiveness of the air knives and accessibility beneath the Heated Storage (SS13) and Garage (SS14) are the data gaps. Clearance beneath the buildings is variable and sometimes less than two feet. A treatability study will be necessary to determine the effectiveness of the air knives. Several parameters must be investigated, including the degree to which the petroleum hydrocarbons have weathered.

Landspreading. The data gaps are the lack of information on site-specific biodegradation potential. A treatability study will be necessary to determine biodegradation potential. Several parameters must be investigated, including pH and baseline microbial activity.

6.4.3 Summary of Detailed Evaluation of Remedial Alternatives

Table 6-17 summarizes the remedial alternatives evaluated by medium. Costs presented in the tables are based on the unit cost developed for each remedial alternative for each site and the estimated volume of each contaminated medium.

6.4.4 Summary of the Nine Criteria

This section consists of an evaluation of the proposed alternatives. The alternatives are arranged by medium with reference to specific sites where it is appropriate, and will be analyzed according to the following nine criteria required in the NCP:

- Overall protection of human health and the environment;
- Compliance with ARARs;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume through treatment;
- Short-term effectiveness;
- Implementability;
- Cost;
- State acceptance (not evaluated at this time); and
- Community acceptance (not evaluated at this time).

State acceptance and community acceptance will be based on comments on the RI/FS report.

TABLE 6-17. SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED (ALL MEDIA)

ALTERNATIVE	MEDIUM	CONTAMINANTS	REMEDIAL ACTION EFFICIENCY FOR DRPH	AVERAGE INITIAL CONCENTRATION OF DRPH* (mg/kg)	TARGET CLEANUP LEVEL FOR DRPH (mg/kg)	POST REMEDIAL CONCENTRATION FOR DRPH (mg/kg)	BENCH OR TREATABILITY STUDY REQUIRED	LEVEL OF WORKER PROTECTION	PROJECT DURATION (Months)	PROJECT COST
No Action	Gravel	DRPH, GRPH, RRPH, Benzene	50%	9,330	500	4,665	NO	D	1	$5,750
	Tundra	DRPH, RRPH	50%	26,250	500	13,125	NO	D	1	$5,750
	Soil Beneath Garage	DRPH, GRPH, RRPH	50%	4,690	500	2,345	NO	D	1	$5,750
Institutional Controls and Monitoring	Gravel	DRPH, GRPH, RRPH, Benzene	50%	9,330	500	4,665	NO	D	29	$66,730
	Tundra	DRPH, RRPH	50%	26,250	500	13,125	NO	D	29	$66,000
	Soil Beneath Garage	DRPH, GRPH, RRPH	50%	4,690	500	2,345	NO	D	29	$66,000
Containment	Soil Beneath Garage	DRPH, GRPH, RRPH	90%	4,690	500	469	NO	C	5	$158,425
Passive Bioremediation	Gravel	DRPH, GRPH, RRPH, Benzene	94%	9,330	500	560	YES	D	33	$167,560
	Tundra	DRPH, RRPH	94%	26,250	500	1,575	YES	D	33	$166,295
	Soil Beneath Garage	DRPH, GRPH, RRPH	94%	4,690	500	281	YES	D	33	$165,020
Biosurfactants	Soil Beneath Garage	DRPH, GRPH, RRPH	90%	4,690	500	281	YES	C	33	$174,125
Landspreading	Gravel	DRPH, GRPH, RRPH, Benzene	75%	9,330	500	2,332	YES	D	34	$217,675

* Based on maximum from individual sites.

The evaluation of the nine criteria is presented in Tables 6-18 through 6-20. The following definitions of the nine criteria, taken from the EPA RI/FS Guidance Document and the NCP, were used.

Overall Protection of Human Health and the Environment. This criterion addresses whether or not a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

Compliance with ARARs. This criterion addresses whether or not a remedy will meet all of the applicable or relevant and appropriate requirements of federal and state environmental statutes and/or provide grounds for invoking a waiver.

Long-term Effectiveness and Permanence. This criterion refers to the ability of a remedy to maintain reliable protection of human health and the environment over time once cleanup goals have been met.

Reduction of Toxicity, Mobility, or Volume Through Treatment. This criterion is the anticipated performance of the treatment technologies a remedy may employ (reflects the anticipated performance of treatment).

Short-term Effectiveness. This criterion addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period until cleanup goals are achieved.

Implementability. This criterion is the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

Cost. Cost includes estimated capital and operation and maintenance costs, and net present work costs.

State Acceptance. State acceptance addresses the technical or administrative issues and concerns the support agency may have regarding each alternative.

Community Acceptance. Community acceptance addresses the issues and concerns the public may have regarding each of the alternatives.

6.4.5 Preferred Alternatives

The selection of preferred alternatives shall be viewed as a general approach rather than a specific action because there are uncertainties regarding the effectiveness of the remedial alternatives in the unusual environmental of the North Slope, future land use, and availability and timing of funding to perform remedial actions. As a result, the alternatives identified in this report as preferred should not be considered the final word. Instead, they should be considered the best available approach pending treatability testing and remedial design.

TABLE 6-18. EVALUATION OF NINE CRITERIA FOR GRAVEL

CRITERIA	NO ACTION	INSTITUTIONAL CONTROLS AND MONITORING	PASSIVE BIOREMEDIATION	LANDSPREADING
1. Overall Protection of Human Health and the Environment	This alternative may not be completely protective of human health and the environment because it may not comply with all chemical-specific ARARs. Therefore, it may not provide sufficient long-term effectiveness and permanence.	This alternative may not be completely protective of human health and the environment because it may not comply with all chemical-specific ARARs. Therefore, it may not provide sufficient long-term effectiveness and permanence.	This alternative is protective of human health and the environment because it reduces the toxicity of COCs to acceptable levels of risk and hazard, provides long-term effectiveness and permanence, and provides short-term effectiveness though it may not comply with chemical-specific ARAR.	This alternative is protective of human health and the environment because it reduces the toxicity of COCs to acceptable levels of risk and hazard, provides long-term effectiveness and permanence, and provides short-term effectiveness though it may not comply with chemical-specific ARAR.
2. Compliance with ARARs	The use of this technology will comply with action specific and location specific ARARs, but may not provide enough reduction to comply with chemical specific ARARs if unsupported bioremediation is unsuccessful.	The use of this technology will comply with action specific and location specific ARARs, but may not provide enough reduction to comply with chemical specific ARARs if unsupported bioremediation is unsuccessful.	The use of this technology may not comply with all chemical specific, but does comply with action and location specific ARARs.	The use of this technology may not comply with all chemical specific, but does comply with action and location specific ARARs.
3. Long-term Effectiveness and Permanence	This alternative may not provide long-term effectiveness because of uncertainties regarding bioremediation potential.	This alternative may not provide long-term effectiveness because of uncertainties regarding bioremediation potential.	This alternative provides sufficient long-term effectiveness because the residual COC concentrations are below relevant risk and hazard levels. It provides permanence because COCs are irreversibly transformed to non-hazardous by-products.	This alternative provides sufficient long-term effectiveness because the residual COC concentrations are below relevant risk and hazard levels. It provides permanence because COCs are irreversibly transformed to non-hazardous by-products.
4. Reduction of Toxicity, Mobility, and Volume Through Treatment	Results in a reduction in toxicity through passive treatment.	Results in a reduction in toxicity through passive treatment.	Results in a reduction in toxicity through treatment.	Results in a reduction in toxicity through treatment.
5. Short-Term Effectiveness	This alternative will not present any detrimental effect on the environment, the surrounding community, or workers.	This alternative will not present any detrimental effect on the environment, the surrounding community, or workers. Recommended worker protection is level D.	This alternative will not present any detrimental effect on the environment, the surrounding community, or workers. Recommended worker protection is level D.	This alternative will not present any detrimental effect on the environment, the surrounding community, or workers. Recommended worker protection is level D.
6. Implementability	This alternative should be technically and administratively implementable, provided that the risk management decisions are acceptable to ADEC.	This alternative is technically and administratively implementable.	Technical implementability will be determined by performing a treatability study. Administrative implementability issues include securing permit. Materials are readily available.	This alternative should be technically implementable if the space is available for spreading. Administrative implementability issues include securing permits. Materials are readily available.

TABLE 6-18. EVALUATION OF NINE CRITERIA FOR GRAVEL (CONTINUED)

CRITERIA	NO ACTION	INSTITUTIONAL CONTROLS AND MONITORING	PASSIVE BIOREMEDIATION	LANDSPREADING
7. Cost	$5,750	$66,730	$167,560	$217,675
8. State/Support Agency	ADEC will be involved in review and selection of remedial alternatives.	ADEC will be involved in review and selection of remedial alternatives.	ADEC will be involved in review and selection of remedial alternatives.	ADEC will be involved in review and selection of remedial alternatives.
9. Community Acceptance	Community Relations Plan is being implemented and community concerns will be addressed in a responsiveness summary.	Community Relations Plan is being implemented and community concerns will be addressed in a responsiveness summary.	Community Relations Plan is being implemented and community concerns will be addressed in a responsiveness summary.	Community Relations Plan is being implemented and community concerns will be addressed in a responsiveness summary.

TABLE 6-19. EVALUATION OF NINE CRITERIA FOR TUNDRA

CRITERIA	NO ACTION	INSTITUTIONAL CONTROLS AND MONITORING	PASSIVE BIOREMEDIATION
1. Overall Protection of Human Health and the Environment	This alternative may not be completely protective of human health and the environment because it may not comply with all chemical-specific ARARs. Therefore, it may not provide sufficient long-term effectiveness and permanence.	This alternative may not be completely protective of human health and the environment because it may not comply with all chemical-specific ARARs. Therefore, it may not provide sufficient long-term effectiveness and permanence.	This alternative is protective of human health and the environment because it reduces the toxicity of COCs to acceptable levels of risk and hazard, provides long-term effectiveness and permanence, and provides short-term effectiveness though it may not comply with chemical-specific ARAR.
2. Compliance with ARARs	The use of this technology will comply with action specific and location specific ARARs, but may not provide enough reduction to comply with chemical specific ARARs if unsupported bioremediation is unsuccessful.	The use of this technology will comply with action specific and location specific ARARs, but may not provide enough reduction to comply with chemical specific ARARs if unsupported bioremediation is unsuccessful.	The use of this technology may not comply with all chemical specific, but does comply with action and location specific ARARs.
3. Long-term Effectiveness and Permanence	This alternative may not provide long-term effectiveness because of uncertainties regarding bioremediation potential.	This alternative may not provide long-term effectiveness because of uncertainties regarding bioremediation potential.	This alternative provides sufficient long-term effectiveness because the residual COC concentrations are below relevant risk and hazard levels. It provides permanence because COCs are irreversibly transformed to non-hazardous by-products.
4. Reduction of Toxicity, Mobility, and Volume Through Treatment	Results in a reduction in toxicity through passive treatment.	Results in a reduction in toxicity through passive treatment.	Results in a reduction in toxicity through treatment.
5. Short-term Effectiveness	This alternative will not present any detrimental effect on the environment, the surrounding community, or workers.	This alternative will not present any detrimental effect on the environment, the surrounding community, or workers.	This alternative will not present any detrimental effect on the environment, the surrounding community, or workers. Recommended worker protection is level D.
6. Implementability	This alternative should be technically and administratively implementable, provided that the risk management decisions are acceptable to ADEC.	This alternative is technically and administratively implementable.	Technical implementability will be determined by performing a treatability study. Administrative implementability issues include securing permit. Materials are readily available.
7. Cost	$5,750	$66,000	$166,295
8. State/Support Agency	ADEC will be involved in review and selection of remedial alternatives.	ADEC will be involved in review and selection of remedial alternatives.	ADEC will be involved in review and selection of remedial alternatives.
9. Community Acceptance	Community Relations Plan is being implemented and community concerns will be addressed in a responsiveness summary.	Community Relations Plan is being implemented and community concerns will be addressed in a responsiveness summary.	Community Relations Plan is being implemented and community concerns will be addressed in a responsiveness summary.

TABLE 6-20. EVALUATION OF NINE CRITERIA FOR THE SOIL BENEATH THE HEATED STORAGE (SS13) AND GARAGE (SS14)

CRITERIA	NO ACTION	INSTITUTIONAL CONTROLS AND MONITORING	CONTAINMENT	PASSIVE BIOREMEDIATION	BIOSURFACTANTS
1. Overall Protection of Human Health and the Environment	This alternative may not be completely protective of human health and the environment because it may not comply with all chemical-specific ARARs. Therefore, it may not provide sufficient long-term effectiveness and permanence.	This alternative may not be completely protective of human health and the environment because it may not comply with all chemical-specific ARARs. Therefore, it may not provide sufficient long-term effectiveness and permanence.	This alternative is protective of human health and the environment as a temporary measure as long as freezing conditions are maintained.	This alternative is protective of human health and the environment because it reduces the toxicity of COCs to acceptable levels of risk and hazard, provides long-term effectiveness and permanence, and provides short-term effectiveness though it may not comply with chemical-specific ARAR.	This alternative is protective of human health and the environment because it reduces the toxicity of COCs to acceptable levels of risk and hazard, provides long-term effectiveness and permanence, and provides short-term effectiveness though it may not comply with chemical-specific ARARs.
2. Compliance with ARARs	The use of this technology will comply with action specific and location specific ARARs, but may not provide enough reduction to comply with chemical specific ARARs if unsupported bioremediation is unsuccessful.	The use of this technology will comply with action specific and location specific ARARs, but may not provide enough reduction to comply with chemical specific ARARs if unsupported bioremediation is unsuccessful.	This alternative complies with action-specific and location-specific ARARs. It does not comply with chemical-specific ARARs.	The use of this technology may not comply with all chemical specific, but does comply with action and location specific ARARs.	The use of this technology may not comply with all action specific, and location specific ARARs. It will not comply with all chemical specific ARARs.
3. Long-term Effectiveness and Permanence	This alternative may not provide long-term effectiveness because of uncertainties regarding bioremediation potential of gravel and the immobility of Aroclor 1254.	This alternative may not provide long-term effectiveness because of uncertainties regarding bioremediation potential.	This alternative does not provide long term effectiveness or permanence. It is intended to be a temporary measure.	This alternative provides sufficient long-term effectiveness because the residual COC concentrations are below relevant risk and hazard levels. It provides permanence because COCs are irreversibly transformed to non-hazardous by-products.	This alternative provides sufficient long-term effectiveness because the residual COC concentrations are below relevant risk and hazard levels. It provides permanence because COCs are irreversibly transformed to non-hazardous by-products.
4. Reduction of Toxicity, Mobility, and Volume Through Treatment	Results in a reduction in toxicity through passive treatment.	Results in a reduction in toxicity through passive treatment.	Results in no reduction in toxicity through treatment.	Results in a reduction in toxicity through treatment.	Results in a reduction in toxicity through treatment.

TABLE 6-20. EVALUATION OF NINE CRITERIA FOR THE SOIL BENEATH THE HEATED STORAGE (SS13) AND GARAGE (SS14) (CONTINUED)

CRITERIA	NO ACTION	INSTITUTIONAL CONTROLS AND MONITORING	CONTAINMENT	PASSIVE BIOREMEDIATION	BIOSURFACTANTS
5. Short-Term Effectiveness	This alternative will not present any detrimental effect on the environment, the surrounding community, or workers.	This alternative will not present any detrimental effect on the environment, the surrounding community, or workers. Recommended worker protection is level D.	This alternative will present no detrimental effect on the environment or surrounding area. Workers may be exposed to COCs and difficult working conditions beneath the Garage.	This alternative will not present any detrimental effect on the environment, the surrounding community, or workers. Recommended worker protection is level D.	This alternative will not present any detrimental effect on the environment, the surrounding community, or workers. Recommended worker protection is level C since biosurfactants may act as an irritant.
6. Implementability	This alternative should be technically and administratively implementable, provided that the risk management decisions are acceptable to ADEC.	This alternative is technically and administratively implementable.	This alternative should be technically and administratively implementable.	Technical implementability will be determined by performing a treatability study. Administrative implementability issues include securing permit. Materials are readily available.	This alternative should be technically implementable if runoff can be collected. Administrative implementability issues include securing permits. Materials are readily available.
7. Cost	$5,750	$66,000	$158,425	$165,020	$174,125
8. State/Support Agency	ADEC will be involved in review and selection of remedial alternatives.	ADEC will be involved in review and selection of remedial alternatives.	ADEC will be involved in review and selection of remedial alternatives.	ADEC will be involved in review and selection of remedial alternatives.	ADEC will be involved in review and selection of remedial alternatives.
9. Community Acceptance	Community Relations Plan is being implemented and community concerns will be addressed in a responsiveness summary.	Community Relations Plan is being implemented and community concerns will be addressed in a responsiveness summary.	Community Relations Plan is being implemented and community concerns will be addressed in a responsiveness summary.	Community Relations Plan is being implemented and community concerns will be addressed in a responsiveness summary.	Community Relations Plan is being implemented and community concerns will be addressed in a responsiveness summary.

The preferred alternatives, presented in Table 6-21, and their estimated costs are listed below by medium:

<u>Gravel</u>

Passive bioremediation contingent on treatability study. The next best alternative is land spreading.	$167,560

<u>Tundra</u>

Passive bioremediation contingent on treatability study. Institutional controls and monitoring is the next best alternative.	$166,295

<u>Soil beneath the Heated Storage (SS13) and Garage (SS14)</u>

Biosurfactants contingent on treatability study. Containment is the next best alternative until the building is removed.	$174,125

<u>Gravel at the White Alice Facility (SS16)</u>

Excavation and offsite disposal.	<u>$111,275</u>
Total	$619,255

TABLE 6-21. RECOMMENDED REMEDIAL ACTION ALTERNATIVES

SITE NAME	SITE ID NUMBER	MEDIUM	RECOMMENDED ALTERNATIVE
POL Catchment	LF03	Gravel	Passive Bioremediation
		Tundra	Passive Bioremediation
Heated Storage	SS13	Gravel	Passive Bioremediation
		Tundra	Passive Bioremediation
		Soil Beneath Building	In Situ Biosurfactants
Garage	SS14	Gravel	Passive Bioremediation
		Soil Beneath Building	In Situ Biosurfactants
White Alice Facility	SS16	Gravel	Excavation and Offsite Incineration

The high concentration of DRPH and other petroleum hydrocarbons makes alternatives that involve active reduction of contamination preferable to no action and institutional controls and monitoring. Among the active reduction alternatives, passive bioremediation is the least costly and most effective for gravel and tundra, assuming that treatability testing supports the viability of biodegradation and that an extensive delivery mechanism is not necessary to distribute oxygen, moisture (for gravel), and nutrients (if necessary). The next best alternative for gravel is landspreading, if nutrients and moisture are part of the landspreading plan. The cost for landspreading is higher than passive bioremediation because more labor is required.

The preferred alternative for tundra is passive bioremediation. The next best alternative for tundra is to implement institutional controls and monitoring. Remedial alternatives more aggressive than passive biodegradation will be likely to lead to greater damage than benefit to fragile tundra.

The soil beneath the Heated Storage (SS13) and Garage (SS14) poses a difficult problem as long as the building remains in place. Some land use scenarios involve donating structures to indigenous Alaskans, so dismantling the Garage is not an option at present. The alternative that is most likely to meet ADEC and public approval is some effort at actively reducing the contamination. Biosurfactants, therefore, should be the preferred alternative, contingent on a successful treatability study. If biosurfactants are not viable, the next best alternative is to contain the contaminants until the building is dismantled or a better remedial alternative is developed. Treatability studies could be conducted using biosurfactants and containment on different areas below one DEW Line garage. Based on the results of the treatability, the selected alternative could be implemented at several DEW Line garages.

6.5 SITING STUDY

Siting of remedial equipment should not be a major concern at Barter Island, because no large remedial units will be used.

ATTACHMENT A
COST ESTIMATES

Alternative: No Action
Estimated Costs

Site:	Media:	Gravel	
POL Catchment (LF03),	Total volume:	116 CY	
Heated Storage Building (SS13),	Project duration:	0.08 yr	(30 days)
and Garage (SS14)	Discount rate:	5% *	

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Total Capital Cost over the 0.08 Year Project				$0	$0
OPERATING COSTS:					
Closure	1	Event	$5,000.00	$5,000	
Total Capital Cost over the 0.08 Year Project				$5,000	$0
Total Capital Cost over the 0.08 Year Project				$5,000	$0
Procurement costs (0%)				$0	$0
Overhead (10%)				$500	$0
Contingency (5%)				$250	$0
Total Capital Cost over the 0.08 Year Project				$750	$0
NET PRESENT WORTH					$5,750

* Estimated discount rate for calculating present value of future costs

Alternative: Institutional Controls and Monitoring
Estimated Costs

Site:	Media:	Gravel	
Combined Sites: LF03, SS13, SS14	Total volume:	205 CY	
	Project duration:	3 yr	(881 days)
	Discount rate:	5% *	

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Planning Documents (Work plan, SAP, QAPjP, H&S)	2	Report	$5,000.00	$10,000	
Misc. Equipment and Supplies	1	Lump Sum	$100.00	$100	
Total Capital Cost over the 3 Year Project				$10,100	$0
OPERATING COSTS:					
Implement Institutional Controls	1	Event	$10,000.00	$10,000	
Sampling	3	Event	$840.00		$2,520
Labor	240	Hr	$70.00	$16,800	
Per Diem	26	Days	$175.00	$4,550	
Project Management	36	Hr	$70.00	$2,520	
Closure (Year 3)	1	Report	$5,000.00	$5,000	
Travel for Sampling	4	Trips	$1,200.00		$4,800
Total Operating Cost over the 3 Year Project				$38,870	$7,320
Total Direct Cost over the 3 Year Project				$48,970	$7,320
Procurement costs (5%)				$2,449	$366
Overhead (10%)				$4,897	$732
Contingency (10%)				$4,897	$732
Total Administrative Cost over the 3 Year Project				$12,243	$1,830
NET PRESENT WORTH					$66,729

* Estimated discount rate for calculating present value of future costs

Alternative: Passive Bioremediation
Estimated Costs

Site:	Media:	Gravel	
POL Catchment (LF03),	Total volume:	205 CY	
Heated Storage Building (SS13),	Project duration:	3 yr	(988 days)
and Garage (SS14)	Discount rate:	5% *	

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Planning Documents (RD/RA) (Work plan, SAP, QAPjP, H&S)	3	Report	$5,000.00	$15,000	
Develop Specifications (30%, 95%, 100%)	3	Report	$5,000.00	$15,000	
Permitting (Air or Water)	1	Permit	$2,000.00	$2,000	
Treatability study	1	Study	$7,500.00	$7,500	
Nutrients	82	Lb	$1.00	$82	
Empty sand bags	14	Bag	$0.47	$7	
Hose	1	Hose	$50.00	$50	
Booms	5	Boom	$24.53	$123	
Trash pump	2	Month	$420.00	$840	
Personal H & S Expendibles	46	Day	$10.00	$460	
Misc. Equipment and Supplies	1	Lump Sum	$1,000.00	$1,000	
Total Capital Cost over the 3 Year Project				$42,061	$0
OPERATING COSTS:					
Mobilize/Demobilize	1	Event	$30,000.00	$30,000	
Transport Nutrients					
Transport Equipment					
Labor	528	Hr	$70.00	$36,960	
Per diem	50	Day	$175.00	$8,750	
Sampling & Analysis (initial)	12	Sample	$70.00	$840	
Sampling & Analysis (annual)	2	Event	$840.00		$1,680
Travel for Sampling	4	Trips	$1,200.00		$4,800
Project Management	79	Hr	$70.00	$5,544	
Closure (Year 3)	1	Report	$5,000.00		$5,000
Total Operating Cost over the 3 Year Project				$82,094	$11,480
Total Direct Cost over the 3 Year Project				$124,155	$11,480
Procurement costs (5%)				$6,208	$574
Overhead (10%)				$12,416	$1,148
Contingency (10%)				$12,416	$1,148
Total Administrative Cost over the 3 Year Project				$31,039	$2,870
NET PRESENT WORTH					**$165,996**

* Estimated discount rate for calculating present value of future costs

Alternative: Land Spreading

Estimated Costs

Site:	Media:	Gravel	
Combined Sites: LF03, SS13, SS14	Total volume:	205 CY	
	Project duration:	3 yr	(1009 days)
	Discount rate:	5% *	

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Planning Documents	3	Report	$5,000.00	$15,000	
(Work plan (or Landspreading Plan), QAPjP, and HASP)	2	Report	$5,000.00	$10,000	
Solid Waste Disposal Permit	1	Permit	$2,000.00	$2,000	
Treatability study	1	Study	$7,500.00	$7,500	
Empty sand bags	10	Bag	$0.47	$5	
Hose	500	LF	$1.00	$500	
Absorbant for runoff control	73	LF	$2.00	$147	
Trash pump	2	Month	$420.00	$840	
Personal H & S Expendibles	88	Day	$10.00	$880	
Silt Fencing	1	Lump Sum	$1,000.00	$1,000	
Back Hoe Rental	1	Month	$15,000	$15,000	
Total Capital Cost over the 3 Year Project				$52,871	$0
OPERATING COSTS:					
Mobilization of equipment for Landspreading	1	Event	$30,000.00	$30,000	
Labor	816	Hr	$70.00	$57,120	
Per diem	92	Day	$175.00	$16,100	
Sampling & Analysis (initial)	12	Sample	$70.00	$840	
Sampling & Analysis (annual)	2	Event	$840.00		$1,680
Travel for Sampling	4	Trips	$1,200.00		$4,800
Project Management	122	Hr	$70.00	$8,568	
Closure (Year 3)	1	Report	$5,000.00		$5,000
Total Operating Cost over the 3 Year Project				$112,628	$11,480
Total Direct Cost over the 3 Year Project				$165,499	$11,480
Procurement costs (5%)				$8,275	$574
Overhead (10%)				$16,550	$1,148
Contingency (10%)				$16,550	$1,148
Total Administrative Cost over the 3 Year Project				$41,375	$2,870
NET PRESENT WORTH					**$217,676**

* Estimated discount rate for calculating present value of future costs

Alternative: No Action
Estimated Costs

<u>Site:</u>	Media:	Tundra	
POL Catchment (LF03)	Total volume:	2,731 CY	
Heated Storage Building (SS13)	Project duration:	0.08 yr	(30 days)
	Discount rate:	5% *	

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Total Capital Cost over the 0.08 Year Project				$0	$0
OPERATING COSTS:					
Closure	1	Event	$5,000.00	$5,000	
Total Capital Cost over the 0.08 Year Project				$5,000	$0
Total Capital Cost over the 0.08 Year Project				$5,000	$0
Procurement costs (0%)				$0	$0
Overhead (10%)				$500	$0
Contingency (5%)				$250	$0
Total Capital Cost over the 0.08 Year Project				$750	$0
NET PRESENT WORTH					$5,750

* Estimated discount rate for calculating present value of future costs

Alternative: Institutional Controls and Monitoring
Estimated Costs

<u>Site:</u>	Media:	Tundra	
POL Catchment (LF03), and	Total volume:	2,731 CY	
Heated Storage Building (SS13)	Project duration:	3 yr	(881 days)
	Discount rate:	5% *	

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Planning Documents (Work plan, SAP, QAPjP, H&S)	2	Report	$5,000.00	$10,000	
Misc. Equipment and Supplies	1	Lump Sum	$100.00	$100	
Total Capital Cost over the 3 Year Project				$10,100	$0
OPERATING COSTS:					
Implement Institutional Controls	1	Event	$10,000.00	$10,000	
Sampling	3	Event	$560.00		$1,680
Labor	240	Hr	$70.00	$16,800	
Per Diem	26	Days	$175.00	$4,550	
Project Management	36	Hr	$70.00	$2,520	
Closure (Year 3)	1	Report	$5,000.00	$5,000	
Travel for Sampling	4	Trips	$1,200.00		$4,800
Total Operating Cost over the 3 Year Project				$38,870	$6,480
Total Direct Cost over the 3 Year Project				$48,970	$6,480
Procurement costs (5%)				$2,449	$324
Overhead (10%)				$4,897	$648
Contingency (10%)				$4,897	$648
Total Administrative Cost over the 3 Year Project				$12,243	$1,620
NET PRESENT WORTH					**$65,999**

* Estimated discount rate for calculating present value of future costs

Alternative: Passive Bioremediation
Estimated Costs

Site:	Media:	Tundra	
POL Catchment (LF03), and	Total volume:	2,731 CY	
Heated Storage Building (SS13)	Project duration:	3 yr	(988 days)
	Discount rate:	5% *	

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Planning Documents (RD/RA) (Work plan, SAP, QAPjP, H&S)	3	Report	$5,000.00	$15,000	
Develop Specifications (30%, 95%, 100%)	3	Report	$5,000.00	$15,000	
Permitting (Air or Water)	1	Permit	$2,000.00	$2,000	
Treatability study	1	Study	$7,500.00	$7,500	
Nutrients	1,093	Lb	$1.00	$1,093	
Empty sand bags	49	Bag	$0.47	$23	
Hose	1	Hose	$50.00	$50	
Booms	5	Boom	$24.53	$123	
Trash pump	2	Month	$420.00	$840	
Personal H & S Expendibles	46	Day	$10.00	$460	
Misc. Equipment and Supplies	1	Lump Sum	$1,000.00	$1,000	
Total Capital Cost over the 3 Year Project				$43,088	$0
OPERATING COSTS:					
Mobilize/Demobilize	1	Event	$30,000.00	$30,000	
Transport Nutrients					
Transport Equipment					
Labor	528	Hr	$70.00	$36,960	
Per diem	50	Day	$175.00	$8,750	
Sampling & Analysis (initial)	8	Sample	$70.00	$560	
Sampling & Analysis (annual)	2	Event	$560.00		$1,120
Travel for Sampling	4	Trips	$1,200.00		$4,800
Project Management	79	Hr	$70.00	$5,544	
Closure (Year 3)	1	Report	$5,000.00		$5,000
Total Operating Cost over the 3 Year Project				$81,814	$10,920
Total Direct Cost over the 3 Year Project				$124,902	$10,920
Procurement costs (5%)				$6,245	$546
Overhead (10%)				$12,490	$1,092
Contingency (10%)				$12,490	$1,092
Total Administrative Cost over the 3 Year Project				$31,226	$2,730
NET PRESENT WORTH					**$166,294**

* Estimated discount rate for calculating present value of future costs

Alternative: No Action
Estimated Costs

Sites:	Media:	Area Under Garage	
Heated Storage Building	Total volume:	222 CY	
Garage (SS14)	Project duration:	0.08 yr	(30 days)
	Discount rate:	5% *	

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Total Capital Cost over the 0.08 Year Project				$0	$0
OPERATING COSTS:					
Closure	1	Event	$5,000.00	$5,000	
Total Capital Cost over the 0.08 Year Project				$5,000	$0
Total Capital Cost over the 0.08 Year Project				$5,000	$0
Procurement costs (0%)				$0	$0
Overhead (10%)				$500	$0
Contingency (5%)				$250	$0
Total Capital Cost over the 0.08 Year Project				$750	$0
NET PRESENT WORTH					**$5,750**

* Estimated discount rate for calculating present value of future costs

Alternative: Institutional Controls and Monitoring
Estimated Costs

Site:	Media:	Soil Under Buildings	
Heated Storage Building (SS13)	Total volume:	222 CY	
Garage (SS14)	Project duration:	3 yr	(881 days)
	Discount rate:	5% *	

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Planning Documents (Work plan, SAP, QAPjP, H&S)	2	Report	$5,000.00	$10,000	
Misc. Equipment and Supplies	1	Lump Sum	$100.00	$100	
Total Capital Cost over the 3 Year Project				$10,100	$0
OPERATING COSTS:					
Implement Institutional Controls	1	Event	$10,000.00	$10,000	
Sampling	3	Event	$560.00		$1,680
Labor	240	Hr	$70.00	$16,800	
Per Diem	26	Days	$175.00	$4,550	
Project Management	36	Hr	$70.00	$2,520	
Closure (Year 3)	1	Report	$5,000.00	$5,000	
Travel for Sampling	4	Trips	$1,200.00		$4,800
Total Operating Cost over the 3 Year Project				$38,870	$6,480
Total Direct Cost over the 3 Year Project				$48,970	$6,480
Procurement costs (5%)				$2,449	$324
Overhead (10%)				$4,897	$648
Contingency (10%)				$4,897	$648
Total Administrative Cost over the 3 Year Project				$12,243	$1,620
NET PRESENT WORTH					**$65,999**

* Estimated discount rate for calculating present value of future costs

Alternative: Containment
Estimated Costs

<u>Sites:</u>	Media:	Soil Under Buildings
Heated Storage Building (SS13)	Total volume:	222 CY
Garage (SS14)	Project duration:	0.33 yr (119 days)
	Discount rate:	5% *

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Planning Documents (RD/RA) (Work plan, SAP, QAPjP, H&S)	3	Report	$5,000.00	$15,000	
Insulation	3,000	Sq Ft	$2.00	$6,000	
Gravel Cover	100	Ton	$100.00	$10,000	
Miscellaneous Equipment (including Heat Exchangers)	1	LS	$5,000.00	$5,000	
Total Capital Cost over the 0.4 Year Project				$36,000	$0
OPERATING COSTS:					
Mobilization	1	Event	$30,000.00	$30,000	
Labor	696	Hr	$70.00	$48,720	
Per diem	72	Day	$175.00	$12,600	
Project Management	104	Hr	$100.00	$10,440	
Total Capital Cost over the 0.4 Year Project				$101,760	$0
Total Capital Cost over the 0.4 Year Project				$137,760	$0
Procurement costs (0%)				$0	$0
Overhead (10%)				$13,776	$0
Contingency (5%)				$6,888	$0
Total Capital Cost over the 0.4 Year Project				$20,664	$0
NET PRESENT WORTH					**$158,424**

* Estimated discount rate for calculating present value of future costs

Alternative: Passive Bioremediation
Estimated Costs

Sites:	Media:	Soil Under Buildings	
Heated Storage Building (SS13)	Total volume:	222 CY	
Garage (SS14)	Project duration:	3 yr	(988 days)
	Discount rate:	5% *	

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Planning Documents (RD/RA) (Work plan, SAP, QAPjP, H&S)	3	Report	$5,000.00	$15,000	
Develop Specifications (30%, 95%, 100%)	3	Report	$5,000.00	$15,000	
Permitting (Air or Water)	1	Permit	$2,000.00	$2,000	
Treatability study	1	Study	$7,500.00	$7,500	
Nutrients	89	Lb	$1.00	$89	
Empty sand bags	13	Bag	$0.47	$6	
Hose	1	Hose	$50.00	$50	
Booms	5	Boom	$24.53	$123	
Trash pump	2	Month	$420.00	$840	
Personal H & S Expendibles	46	Day	$10.00	$460	
Misc. Equipment and Supplies	1	Lump Sum	$1,000.00	$1,000	
Total Capital Cost over the 3 Year Project				$42,068	$0
OPERATING COSTS:					
Mobilize/Demobilize	1	Event	$30,000.00	$30,000	
Transport Nutrients					
Transport Equipment					
Labor	528	Hr	$70.00	$36,960	
Per diem	50	Day	$175.00	$8,750	
Sampling & Analysis (initial)	8	Sample	$70.00	$560	
Sampling & Analysis (annual)	2	Event	$560.00		$1,120
Travel for Sampling	4	Trips	$1,200.00		$4,800
Project Management	79	Hr	$70.00	$5,544	
Closure (Year 3)	1	Report	$5,000.00		$5,000
Total Operating Cost over the 3 Year Project				$81,814	$10,920
Total Direct Cost over the 3 Year Project				$123,882	$10,920
Procurement costs (5%)				$6,194	$546
Overhead (10%)				$12,388	$1,092
Contingency (10%)				$12,388	$1,092
Total Administrative Cost over the 3 Year Project				$30,970	$2,730
NET PRESENT WORTH					**$165,018**

* Estimated discount rate for calculating present value of future costs

Alternative: Biosurfactants
Estimated Costs

Sites:	Media:	Soil Under Building	
Heated Storage Building (SS13)	Total volume:	222 CY	
Garage (SS14)	Project duration:	2 yr	(596 days)
	Discount rate:	5% *	

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Planning Documents (RD/RA)	3	Report	$5,000.00	$15,000	
(Work plan, SAP, QAPjP, H&S)					
Develop Specifications	3	Report	$5,000.00	$15,000	
(30%, 95%, 100%)					
Permitting (Air & Water)	2	Permit	$2,000.00	$4,000	
Treatability study	1	Study	$7,500.00	$7,500	
Air Knife Purchase (pair)	1	Pair	$6,000.00	$6,000	
Compressor	1	Month	$2,000.00	$2,000	
Microbes	0	Gal	$20.90	$0	
Nutrients	89	Lb	$1.00	$89	
Empty sand bags	14	Bag	$0.47	$7	
Hose	500	LF	$1.00	$500	
Booms	5	Boom	$24.53	$123	
Trash pump	1	Month	$420.00	$420	
Personal H & S Expendibles	40	Day	$10.00	$400	
Misc. Equipment and Supplies	1	Lump Sum	$1,000.00	$1,000	
Total Capital Cost over the 2 Year Project				$52,038	$0
OPERATING COSTS:					
Mobilization	1	Event	$30,000.00	$30,000	
Transport Microbes					
Transport Nutrients					
Transport Equipment					
Labor	480	Hr	$70.00	$33,600	
Per diem	44	Day	$175.00	$7,700	
Sampling & Analysis (initial)	8	Sample	$70.00	$560	
Sampling & Analysis (annual)	2	Event	$560.00		$1,120
Travel for Sampling	4	Trips	$1,200.00		$4,800
Project Management	72	Hr	$70.00	$5,040	
Closure (Year 2)	1	Report	$7,500.00		$7,500
Total Operating Cost over the 2 Year Project				$76,900	$13,420
Total Direct Cost over the 2 Year Project				$128,938	$13,420
Procurement costs (5%)				$6,447	$671
Overhead (10%)				$12,894	$1,342
Contingency (10%)				$12,894	$1,342
Total Administrative Cost over the 2 Year Project				$32,235	$3,355
NET PRESENT WORTH					**$174,123**

* Estimated discount rate for calculating present value of future costs

Alternative: Excavation and Incineration
Estimated Costs

Site:	Media:	PCB Contaminated Gravel	
White Alice Facility (SS16)	Total volume:	2.0 CY	
	Project duration:	1 yr.	(145 days)
	Discount rate:	5% *	

Description	Quantity	Units	Unit Cost	Fixed Cost	Annual Cost
CAPITAL COSTS:					
Planning Documents (RD/RA) (Work plan, SAP, QAPjP, H&S)	2	Draft	$10,000.00	$20,000	
Develop Specifications (Draft and Final)	2	Draft	$7,500.00	$15,000	
Drum Cost	8	Drum	$42.50	$340	
Personal H & S Expendibles	8	Day	$10.00	$80	
Misc. Equipment and Supplies	1	Amount	$100.00	$100	
Total Capital Cost over the 1 yr. Year Project				$35,520	$0
OPERATING COSTS:					
Mobilize/Demobilize	1	Event	$3,000.00	$3,000	
Transport Equipment	1	Event	$2,000.00	$2,000	
Transportation and Incineration	8	Drum	$1,359.00	$10,872	
Waste Profiling	1	Event	$750.00	$750	
Documentation	1	Event	$200.00	$200	
Labor	112	Hr	$70.00	$7,840	
Per diem	12	Day	$175.00	$2,100	
Sampling & Analysis (initial)	3	Sample	$200.00	$600	
Project Management	116	Hr	$100.00	$11,600	
Closure	1	Report	$5,000.00	$5,000	
Total Operating Cost over the 1 yr. Year Project				$43,962	$0
Total Direct Cost over the 1 yr. Year Project				$79,482	$0
Procurement costs (5%)				$3,974	$0
Overhead (10%)				$7,948	$0
Contingency (10%)				$19,871	$0
Total Administrative Cost over the 1 yr. Year Project				$31,793	$0
NET PRESENT WORTH					**$111,275**

* Estimated discount rate for calculating present value of future costs

ATTACHMENT B
ESTIMATED PROJECT DURATIONS

Alternative: No Action
Estimated Project Duration

Site:
POL Catchment (LF03),
Heated Storage Building (SS13),
and Garage (SS14)

Start Date: Day 1
Medium: Gravel

Activity	Duration	Start Date	End Date
Development of Closure Report	30 Days	Day 1	Day 30
Closure	0 Days	Day 30	Day 30
PROJECT DURATION	30 Days		

Alternative: Institutional Controls and Monitoring
Estimated Project Duration

Site:
Combined Sites: LF03, SS13, SS14

Start Date: Day 1
Medium: Gravel

Activity	Duration	Start Date	End Date
Development of Planning Documents	60 Days	Day 1	Day 60
Implementation of Institutional Controls	60 Days	Day 61	Day 120
Mobilization	2 Days	Day 121	Day 122
Preliminary Sampling	3 Days	Day 123	Day 125
Demobilization	2 Days	Day 126	Day 127
End of First Year Sampling	3 Days	Day 487	Day 489
End of Second Year Sampling	3 Days	Day 849	Day 851
Development of Closure Report	30 Days	Day 852	Day 881
Closure	0 Days	Day 881	Day 881
PROJECT DURATION	881 Days		

Alternative: Passive Bioremediation
Estimated Project Duration

Sites:
POL Catchment (LF03),
Heated Storage Building (SS13),
and Garage (SS14)

Start Date: Day 1
Media: Gravel

Activity	Duration	Start Date	End Date
Treatability Study	60 Days	Day 1	Day 60
Development of Planning Documents	90 Days	Day 61	Day 150
Development of Specifications	60 Days	Day 61	Day 120
Permits	60 Days	Day 151	Day 210
Mobilization	7 Days	Day 211	Day 217
Preliminary Sampling	3 Days	Day 218	Day 220
Application of Nutrients, Microbes, and Water	7 Days	Day 221	Day 227
Demobilization	7 Days	Day 228	Day 234
End of First Year Sampling	3 Days	Day 594	Day 596
End of Second Year Sampling	3 Days	Day 956	Day 958
Development of Closure Report	30 Days	Day 959	Day 988
Closure	0 Days	Day 988	Day 988
PROJECT DURATION	988 Days		

Alternative: Land Spreading of Gravel, Estimated Project Duration

Site:
Combined Sites: LF03, SS13, SS14

Start Date: Day 1
Media: Gravel

Activity	Duration	Start Date	End Date
Treatability Study	60 Days	Day 1	Day 60
Development of Planning Documents	90 Days	Day 61	Day 150
Development of Landspreading Plan	60 Days	Day 61	Day 120
Solid Waste Disposal Permit	60 Days	Day 151	Day 210
Mobilization	7 Days	Day 211	Day 217
Preliminary Sampling	3 Days	Day 218	Day 220
Landspreading and Application of Water	21 Days	Day 221	Day 241
Demobilization	7 Days	Day 242	Day 248
End of First Year Sampling and Reapplication of Water	10 Days	Day 608	Day 617
End of Second Year Sampling and	3 Days	Day 977	Day 979
Development of Closure Report	30 Days	Day 980	Day 1009
Closure	0 Days	Day 1009	Day 1009
PROJECT DURATION	1009 Days		

Alternative: No Action
Estimated Project Duration

Site:
POL Catchment (LF03)
Heated Storage Building (SS13)

Start Date: Day 1
Medium: Tundra

Activity	Duration	Start Date	End Date
Development of Closure Report	30 Days	Day 1	Day 30
Closure	0 Days	Day 30	Day 30
PROJECT DURATION	30 Days		

Alternative: Institutional Controls and Monitoring
Estimated Project Duration

Site:
POL Catchment (LF03), and
Heated Storage Building (SS13)

Start Date: Day 1
Medium: Tundra

Activity	Duration	Start Date	End Date
Development of Planning Documents	60 Days	Day 1	Day 60
Implementation of Institutional Controls	60 Days	Day 61	Day 120
Mobilization	2 Days	Day 121	Day 122
Preliminary Sampling	3 Days	Day 123	Day 125
Demobilization	2 Days	Day 126	Day 127
End of First Year Sampling	3 Days	Day 487	Day 489
End of Second Year Sampling	3 Days	Day 849	Day 851
Development of Closure Report	30 Days	Day 852	Day 881
Closure	0 Days	Day 881	Day 881
PROJECT DURATION	881 Days		

Alternative: Passive Bioremediation
Estimated Project Duration

Sites:
POL Catchment (LF03), and
Heated Storage Building (SS13)

Start Date: Day 1
Media: Tundra

Activity	Duration	Start Date	End Date
Treatability Study	60 Days	Day 1	Day 60
Development of Planning Documents	90 Days	Day 61	Day 150
Development of Specifications	60 Days	Day 61	Day 120
Permits	60 Days	Day 151	Day 210
Mobilization	7 Days	Day 211	Day 217
Preliminary Sampling	3 Days	Day 218	Day 220
Application of Nutrients, Microbes, and Water	7 Days	Day 221	Day 227
Demobilization	7 Days	Day 228	Day 234
End of First Year Sampling	3 Days	Day 594	Day 596
End of Second Year Sampling	3 Days	Day 956	Day 958
Development of Closure Report	30 Days	Day 959	Day 988
Closure	0 Days	Day 988	Day 988
PROJECT DURATION	988 Days		

Alternative: No Action
Estimated Project Duration

Sites:
Heated Storage Building (SS13) Start Date: Day 1
Garage (SS14) Medium: Area Under Garage

Activity	Duration	Start Date	End Date
Development of Closure Report	30 Days	Day 1	Day 30
Closure	0 Days	Day 30	Day 30
PROJECT DURATION	30 Days		

Alternative: Institutional Controls and Monitoring
Estimated Project Duration

Site:
Heated Storage Building (SS13)
Garage (SS14)

Start Date: Day 1
Medium: Soil Under Buildings

Activity	Duration	Start Date	End Date
Development of Planning Documents	60 Days	Day 1	Day 60
Implementation of Institutional Controls	60 Days	Day 61	Day 120
Mobilization	2 Days	Day 121	Day 122
Preliminary Sampling	3 Days	Day 123	Day 125
Demobilization	2 Days	Day 126	Day 127
End of First Year Sampling	3 Days	Day 487	Day 489
End of Second Year Sampling	3 Days	Day 849	Day 851
Development of Closure Report	30 Days	Day 852	Day 881
Closure	0 Days	Day 881	Day 881
PROJECT DURATION	881 Days		

Alternative: Containment
Estimated Project Duration

Sites:
Heated Storage Building (SS13) — Start Date: Day 1
Garage (SS14) — Medium: Soil Under Buildings

Activity	Duration	Start Date	End Date
Development of Planning Documents	90 Days	Day 1	Day 90
Mobilization	7 Days	Day 91	Day 97
Installation of Containment	15 Days	Day 98	Day 112
Demobilization	7 Days	Day 113	Day 119
PROJECT DURATION	119 Days		

Alternative: Passive Bioremediation
Estimated Project Duration

Sites:
Heated Storage Building (SS13) Start Date: Day 1
Garage (SS14) Media: Soil Under Buildings

Activity	Duration	Start Date	End Date
Treatability Study	60 Days	Day 1	Day 60
Development of Planning Documents	90 Days	Day 61	Day 150
Development of Specifications	60 Days	Day 61	Day 120
Permits	60 Days	Day 151	Day 210
Mobilization	7 Days	Day 211	Day 217
Preliminary Sampling	3 Days	Day 218	Day 220
Application of Nutrients, Microbes, and Water	7 Days	Day 221	Day 227
Demobilization	7 Days	Day 228	Day 234
End of First Year Sampling	3 Days	Day 594	Day 596
End of Second Year Sampling	3 Days	Day 956	Day 958
Development of Closure Report	30 Days	Day 959	Day 988
Closure	0 Days	Day 988	Day 988
PROJECT DURATION	988 Days		

Alternative: Biosurfactants
Estimated Project Duration

Sites:
Heated Storage Building (SS13) — Start Date: Day 1
Garage (SS14) — Media: Soil Under Building

Activity	Duration	Start Date	End Date
Treatability Study	60 Days	Day 1	Day 60
Development of Planning Documents	90 Days	Day 61	Day 150
Development of Specifications	60 Days	Day 61	Day 120
Permits	60 Days	Day 151	Day 210
Mobilization	7 Days	Day 211	Day 217
Preliminary Sampling	3 Days	Day 218	Day 220
Application of Biosurfactant to soil and Requisite Nutrients to Tank of Collected Water	7 Days	Day 221	Day 227
Demobilization	7 Days	Day 228	Day 234
End of First Year Sampling	3 Days	Day 594	Day 596
Closure	0 Days	Day 596	Day 596
PROJECT DURATION	596 Days		

Alternative: Excavation and Incineration
Estimated Project Duration

Site:
White Alice Facility (SS16)

Start Date: Day 1
Media: PCB Contaminated Gravel

Activity	Duration	Start Date	End Date
Development of Planning Documents	90 Days	Day 1	Day 90
Development of Specifications	60 Days	Day 1	Day 60
Mobilization	14 Days	Day 91	Day 104
Preliminary Sampling	1 Days	Day 108	Day 108
Remediation	2 Days	Day 106	Day 107
Final Sampling	1 Days	Day 108	Day 108
Demobilization	7 Days	Day 109	Day 115
Development of Closure Report	30 Days	Day 116	Day 145
Secure Closure	0 Days	Day 145	Day 145
PROJECT DURATION	145 Days		

APPENDIX A

REFERENCES AND LIST OF ACRONYMS, ABBREVIATIONS, AND UNITS OF MEASUREMENT

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LIST OF ACRONYMS, ABBREVIATIONS, AND UNITS OF MEASUREMENT

ADEC	Alaska Department of Environmental Conservation
AFCEE	Air Force Center for Environmental Excellence
Air Force	United States Air Force
ANWR	Alaska National Wildlife Refuge
ARARs	Applicable or Relevant and Appropriate Requirements
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	Chemical of Concern
CT&E	Commercial Testing & Engineering Co.
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DEW	Distant Early Warning
DOD	Department of Defense
DRPH	Diesel Range Petroleum Hydrocarbons
EPA	U.S. Environmental Protection Agency
ERA	Ecological Risk Assessment
F&B	Friedman & Bruya, Inc.
FS	Feasibility Study
FWPCA	Federal Water Pollution Control Act
GC/MS	Gas Chromatography/Mass Spectrometry
GRAs	General Response Actions
GRO	Gasoline Range Organics
GRPH	Gasoline Range Petroleum Hydrocarbons
HQ	Hazard Quotient
HVOC	Halogenated Volatile Organic Compound
ICP	Inductively Coupled Plasma
IRP	Installation Restoration Program
MOGAS	Motor Vehicle Gasoline
MSL	Mean Sea Level
NCP	National Contingency Plan
NPL	National Priority List
PCB	Polychlorinated Biphenyls
POL	Petroleum, Oils, and Lubricants
QAPjP	Quality Assurance Project Plan
RAGS	Risk Assessment Guidance for Superfund
RBSLs	Risk-Based Screening Levels
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study

LIST OF ACRONYMS, ABBREVIATIONS, AND UNITS OF MEASUREMENT (CONTINUED)

RI	Remedial Investigation
RRPH	Residual Range Petroleum Hydrocarbons
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act of 1986
SVOC	Semi-Volatile Organic Compound
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TPH	Total Petroleum Hydrocarbons
TOC	Total Organic Carbon
TRVs	Toxicity Reference Values
TSS	Total Suspended Solids
UCL	Upper Confidence Limit
VOC	Volatile Organic Compound

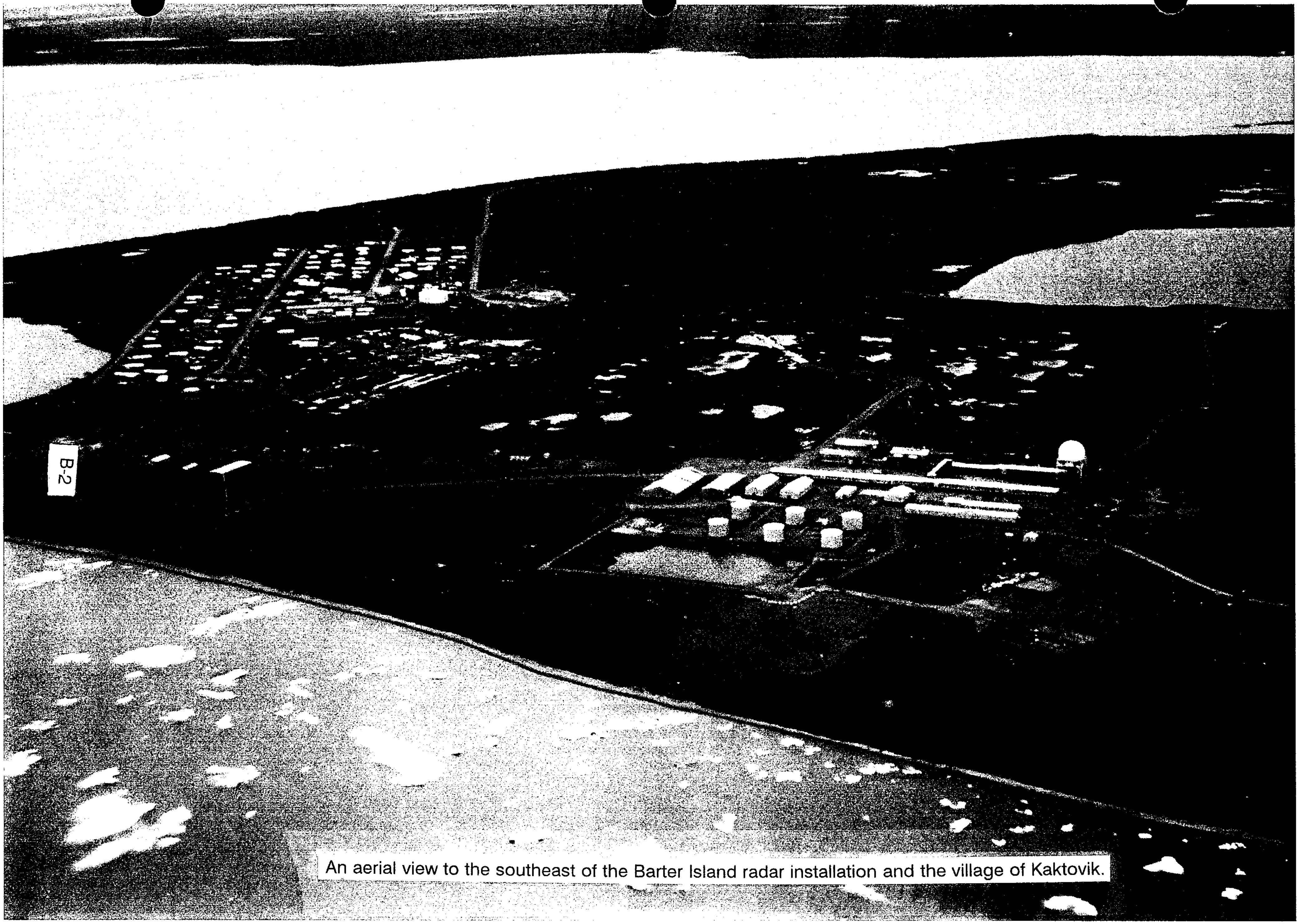
MEASUREMENTS

µg/L	micrograms per liter
cy	cubic yards
gpm	gallons per minute
mg/kg	miligrams per kilogram
ppb	parts per billion
ppm	parts per million

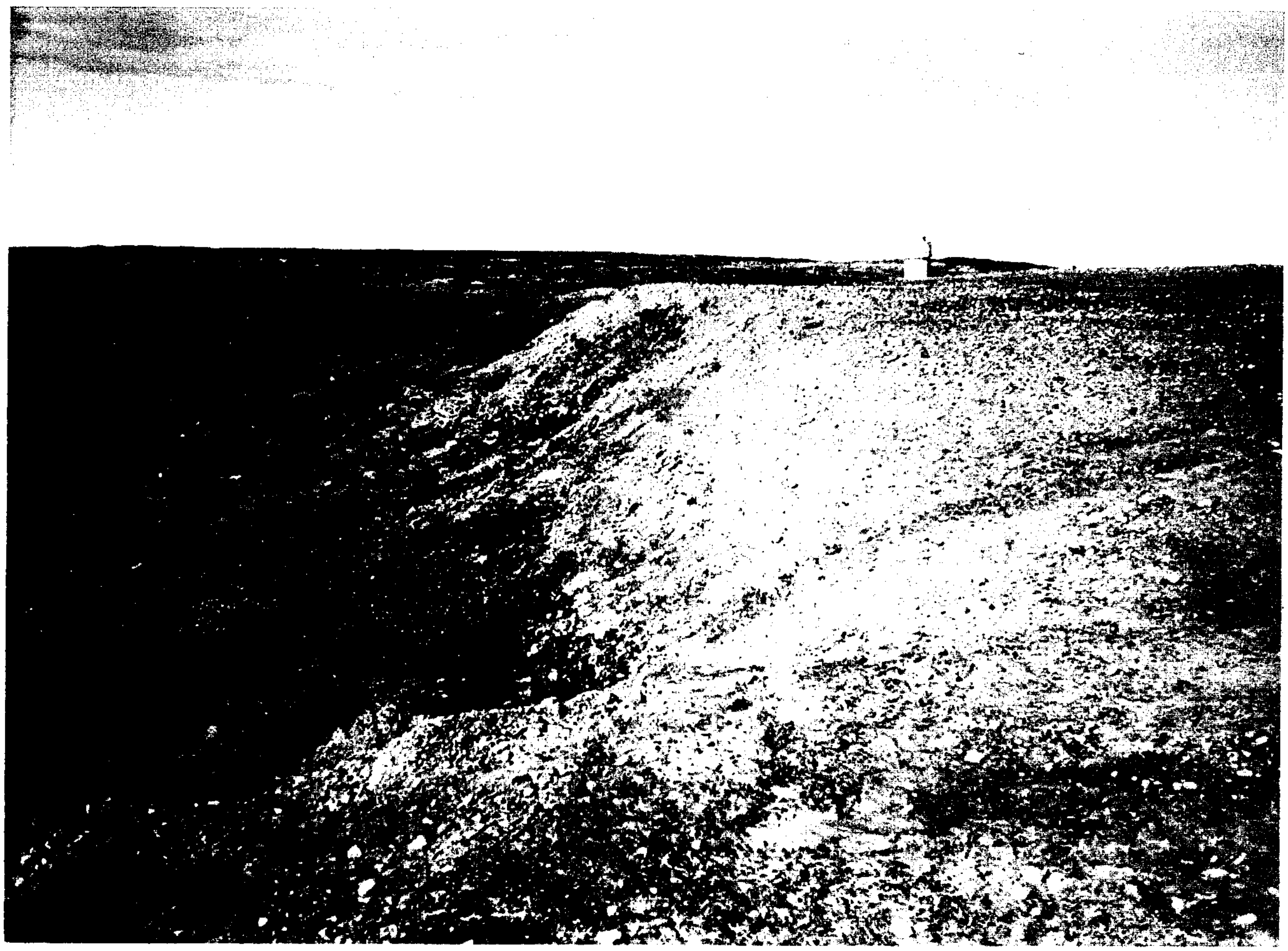
APPENDIX B

PHOTOGRAPHS OF BARTER ISLAND RADAR INSTALLATION AND SITES

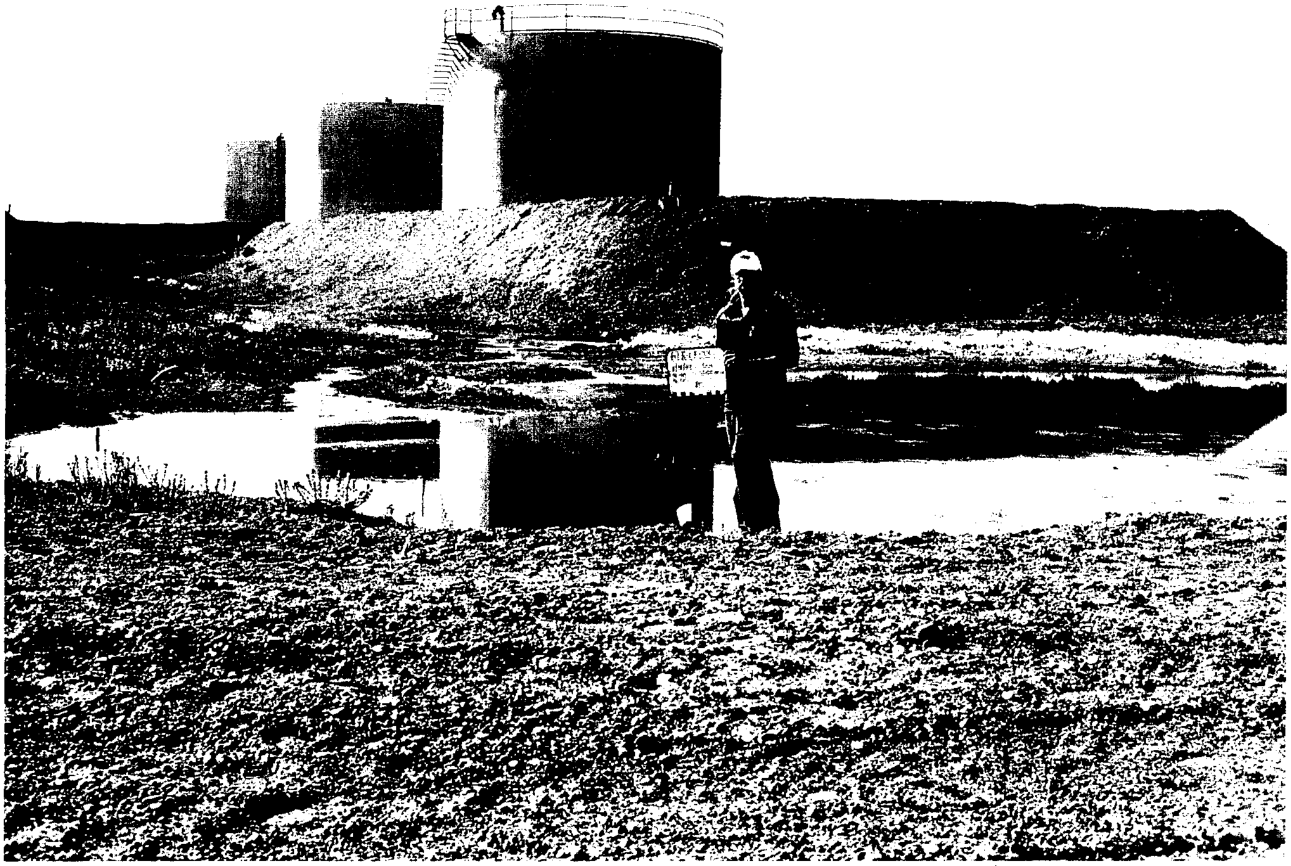
An aerial view to the north of the Barter Island radar installation, Alaska.



An aerial view to the southeast of the Barter Island radar installation and the village of Kaktovik.



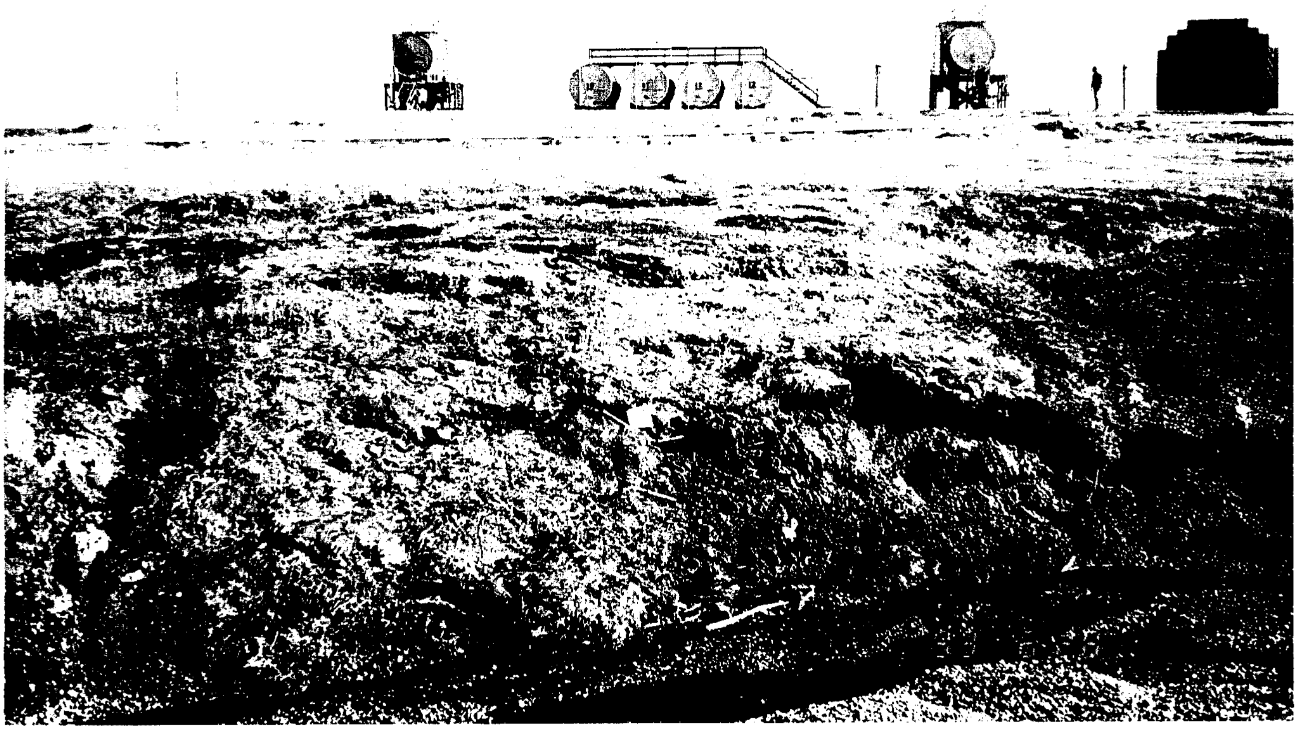
View to the north of the west side of the Old Landfill (LF01) site. This area was regraded and recompacted in 1993. An incised stream runs along the western boundary of the site.



The POL Catchment (LF03) site is a tundra area surrounded by a berm. This is a view to the west from the east berm looking towards the POL Tanks (ST17) site. Note: vegetation (Alaska cottongrass) in catchment basin area not covered with water.

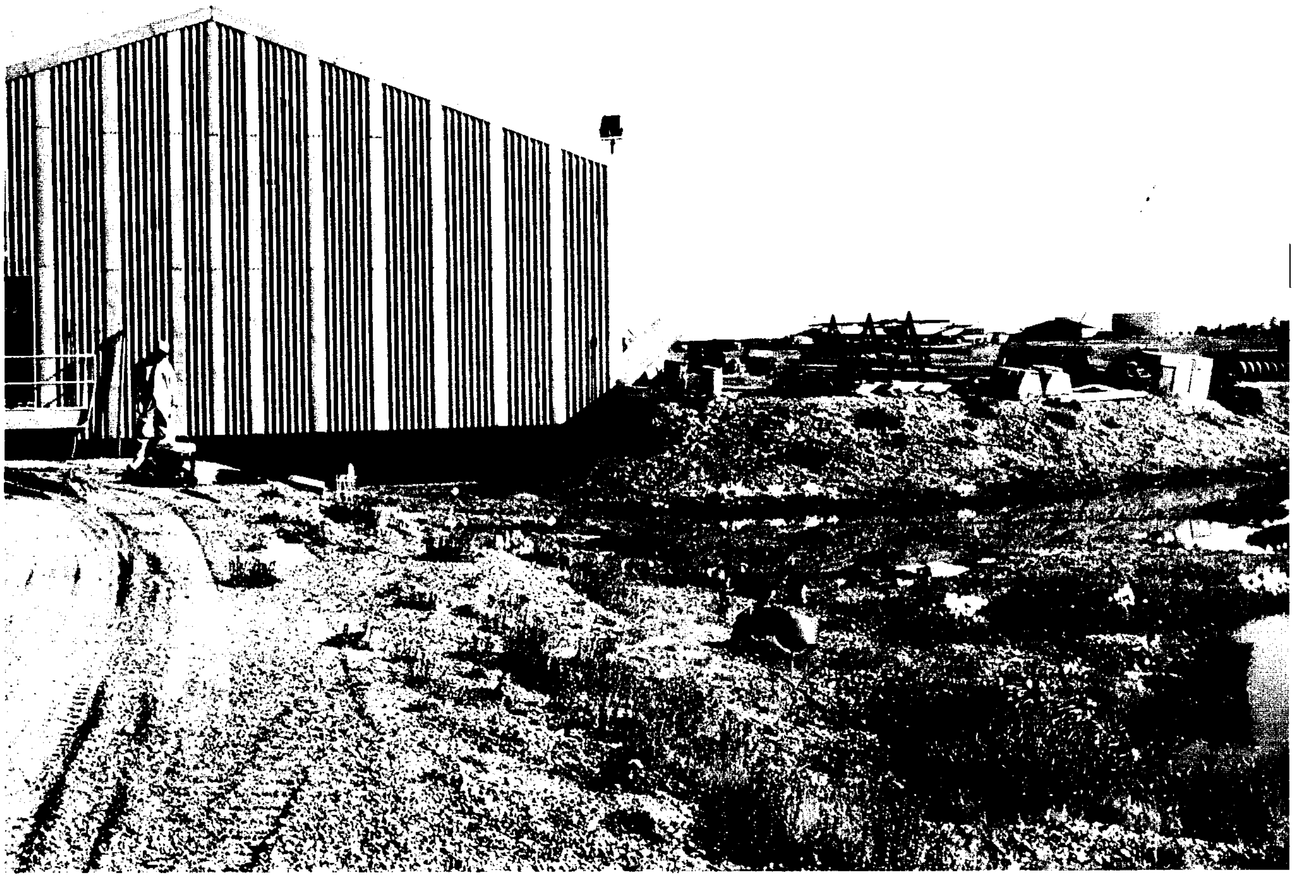
View to the south of the Current Landfill (LF04) site; right side of photo. Debris can be seen scattered along the north boundary of the landfill.

A view to the south of the Contaminated Ditch (SD08) site. The site extends from the bottom left of this photo to the center right. The Old Dump Site (LF19) is located to the left of the Contaminated Ditch in the lower left area of the photo.



A view to the south of the Contaminated Ditch (SD08) site. The Fuel Tanks (ST18) site is shown in the background.

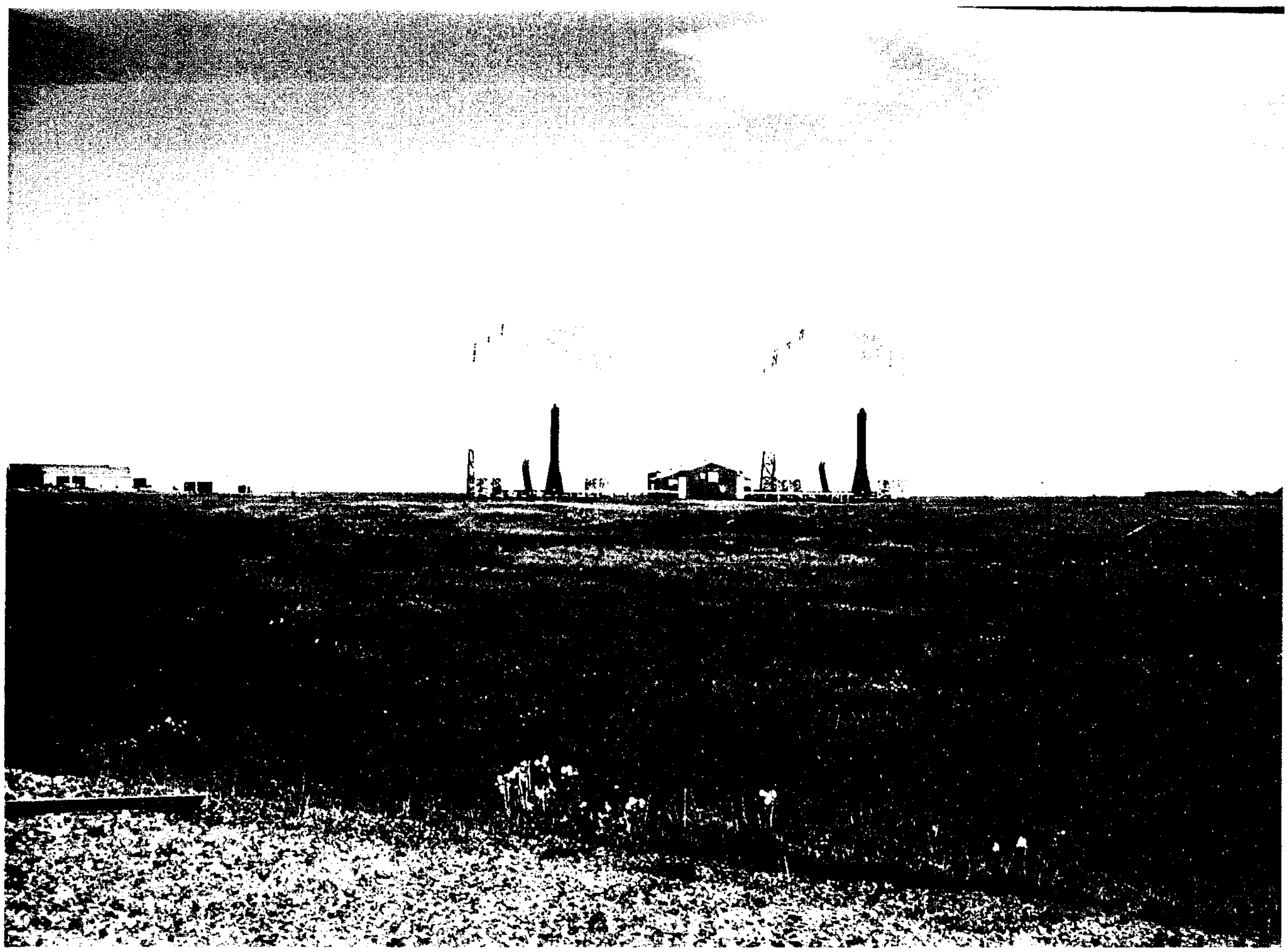
View to the north of the Old Runway Dump (LF12) site. Whale remains are currently dumped here by the local community to deter the polar bears away from the village.



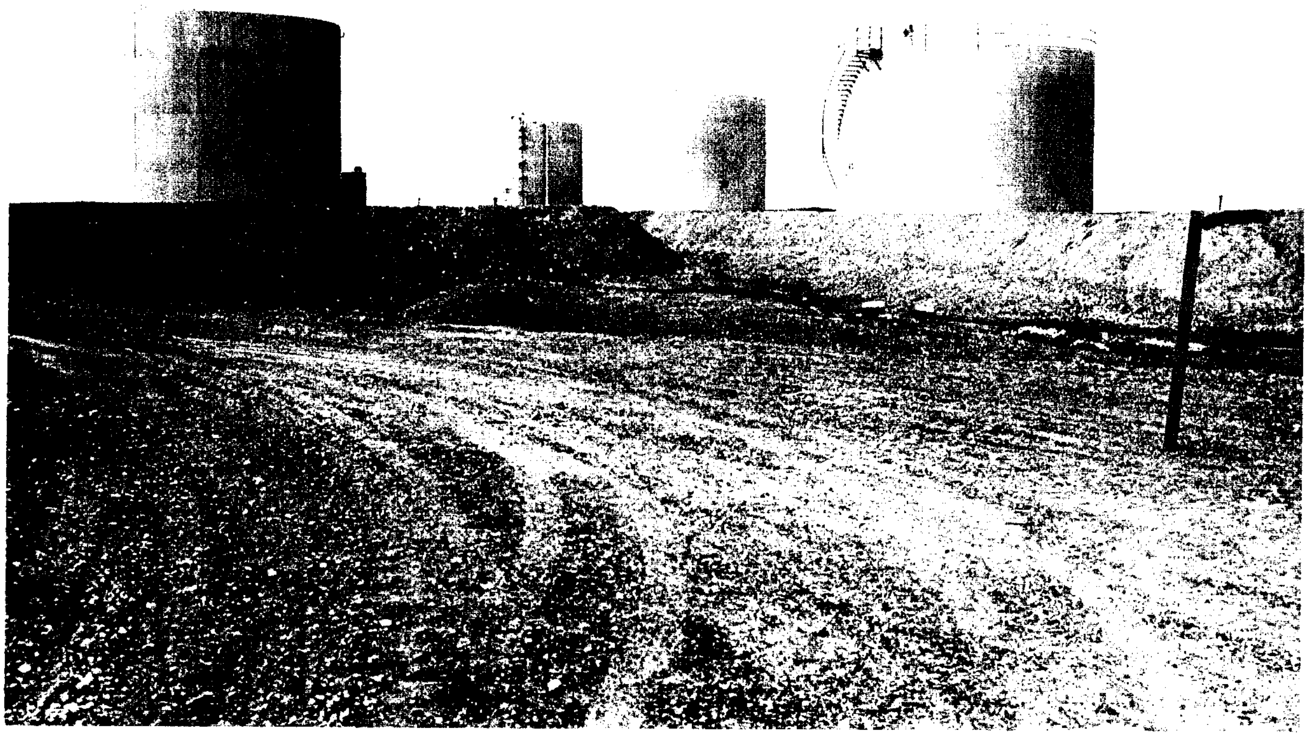
This is a view to the east of the west side of the Heated Storage (Building 87) (SS13) site.

A view to the west of the east end of the Garage (SS14) site.

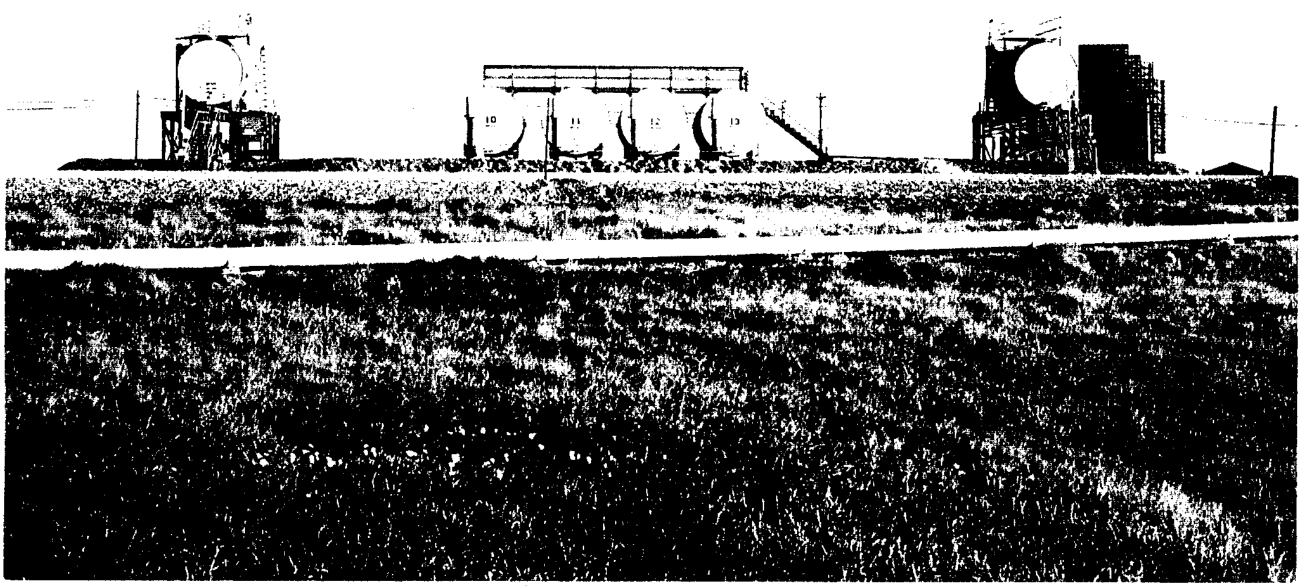
A view to the south of the Weather Station Building (SS15) site. The 1,200-gallon diesel fuel tank adjacent to the building appears to be the source of contamination at this site.



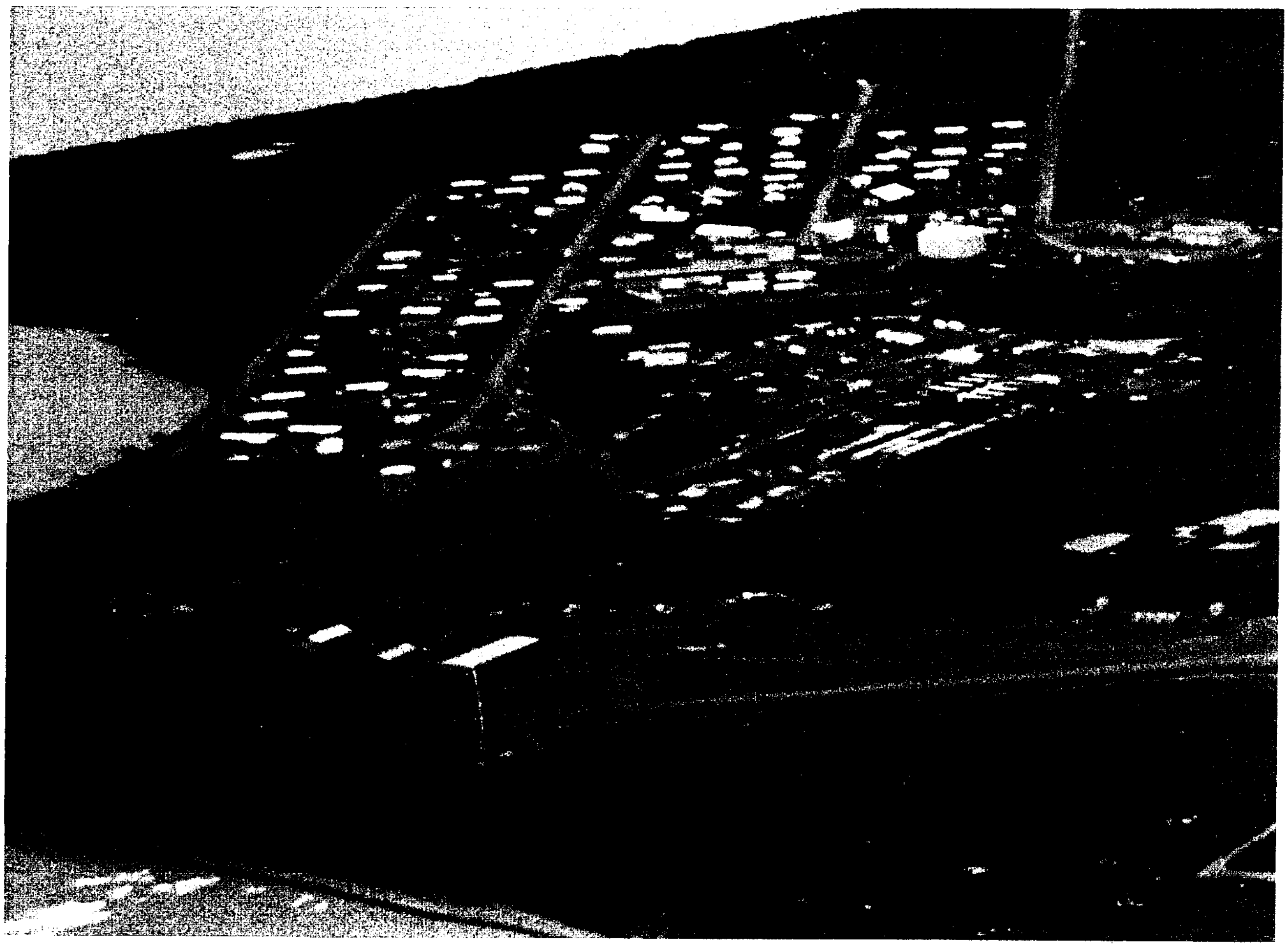
View to the north of the White Alice Facility (SS16) site.



The POL Tanks (ST17) site. This is a view towards the northwest from the gravel pad from the southeast of the POL Tanks.



The Fuel Tanks (ST18) are used to store gasoline and diesel. The tanks are surrounded by a berm. This is a view to the south showing the north side of the six storage tanks within the site.



An aerial view to the southeast of the Old Dump Site (LF19) and Kaktovik. The Old Dump Site, the area to the left of the ditch, was the location of the village of Kaktovik from 1952 to 1964.

View to the southeast of the Bladder Diesel Spill (SS20) site located just west of module train B. Site personnel reported this area as the location of a historic spill.

The JP-4 Spill (SS21) site. The arrow designates area in fuel line where the spill occurred. View is to the south with Kaktovik in the background.

APPENDIX C

COPY OF THE TASK DESCRIPTIONS AND STATEMENT OF WORK

REF 88X

ORDER FOR SUPPLIES OR SERVICES

88X

1. PAGE 1 OF 3

2. PROC INSTRUMENT ID NUMBER (PIN): F33615-90-D-4010
MARK ALL PACKAGES AND PAPERS WITH THIS NUMBER

3. CALL/ORDER NUMBER: 0022

4. DATE OF ORDER*: 8 APR 1993

5. REQUISITION/PURCHASE REQUEST PROJECT NUMBER: FY7624-93-08202

6. CERTIFIED FOR NATIONAL DEFENSE UNDER DO-C9 (BDC REG 2/DMS REG 1 RATING)

7. ISSUED BY — CODE FQ2826
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BROOKS AFB TX 78235-5353
BUYER: EDWIN CUSTODIO/HSC-PKVBA
PHONE: (210) 536-4493

8. ADMINISTERED BY — CODE S2101A
DCASMA BALTIMORE
200 TOWSONTOWN BLVD, WEST
TOWSON MD 21204-5299

9. CONTRACTOR NAME AND ADDRESS — CODE 69148 — FACILITY CODE
ICF TECHNOLOGY, INC
9300 LEE HIGHWAY
FAIRFAX VA 22031-1207

PHONE: (703) 934-3000
COUNTY: FAIRFAX

IF "X" FOR MULTIPLE FACILITIES SEE SECT "G"

10. MAIL INVOICES TO: U

11. DISCOUNT FOR PROMPT PAYMENT

	%	DAYS	NET DAYS
1ST N	%	DAYS	
2ND	%	DAYS	OTHER
3RD	%	DAYS	IF "Y" SEE SECT "G"

12A. PURCHASE OFFICE POINT OF CONTACT: MVH/M6V/MVY

12B. RESERVED FOR SERVICE/AGENCY USE

13. PAYMENT WILL BE MADE BY — CODE S3910A IF "Y" SEE SECT "G"
DCASR, PHILADELPHIA
P.O. BOX 7730
PHILADELPHIA, PA 19101-7478

14. TYPE CONTRACTOR: A

15. SECURITY A. CLASSIFICATION: U — B. DATE OF DD 254

16. CONTRACT ADMINISTRATION

A. FAST PAY	B. CONTRACT (1) KIND	(2) TYPE	C. ABSTRACT RECIP ADP POINT	D. SPL CONT PROVISIONS	E. CONT ADMIN FUNC LMT	17. (RESERVED)	18. SVC/AGENCY USE	19. SURV. CRIT	20. TOTAL AMOUNT
	1	Y						C	NOT-TO-EXCEED $299,855.00

21. APPROPRIATION AND ACCOUNTING DATA

A. ACTY CLAS: U — B. ACRN: AA — C. APPROPRIATION: 5733400 — D. LIMIT SUBHEAD — E. SUPPLEMENTAL ACCOUNTING CLASSIFICATION

F. OPN RECIPIENT DODAAD: F74400 — G. OBLIGATION AMOUNT: $299,855.00 — H. NON-CLERICAL PAYMENT(PIIN): 303 7434 434419 00007 53440 78008F 674400 — I. SVC AGENCY USE: FY7624-93-08202

22A. TYPE OF ORDER: DELIVERY X — PURCHASE

B. NON-DOD CONTRACT NUMBER
This delivery order is subject to instructions contained on this side of form only and is issued in accordance with and subject to terms and conditions of above numbered contract, or Non-DOD Contract Number.

Reference your

Furnish the following on terms specified herein.

If quantity accepted by the Government is same as quantity ordered, indicate by mark. If different, enter actual quantity accepted below quantity ordered and encircle.

23. UNITED STATES OF AMERICA
BY: GARY J. MACDECY — Gary J. Macdecy 93APR08
NAME OF CONTRACTING/ORDERING OFFICER AND DATE (YYMMDD)

24. TOTAL

25. DIFFERENCES

25. QUANTITY ORDERED HAS BEEN
☐ INSPECTED ☐ RECEIVED ☐ ACCEPTED, AND CONFORMS TO THE CONTRACT EXCEPT AS STATED

26. SHIP NUMBER ☐ PARTIAL ☐ FINAL

27. D.O. VOUCHER NUMBER

28. INITIALS

DATE — SIGNATURE OF AUTHORIZED GOVERNMENT REPRESENTATIVE

31. PAID BY

32. AMOUNT VERIFIED CORRECT FOR

36. I CERTIFY THIS AMOUNT IS CORRECT AND PROPER FOR PAYMENT

30. PAYMENT ☐ COMPLETE ☐ PARTIAL ☐ FINAL

33. CHECK NUMBER

SIGNATURE AND TITLE OF CERTIFYING OFFICER

34. BILL OF LADING NUMBER

RECEIVED AT — 37. RECEIVED BY — 38. DATE RECEIVED — 39. TOTAL CONTAINERS — 40. S/R ACCOUNT NUMBER — 41. S/R VOUCHER NUMBER

AFSC Form 700, DEC 88 — PREVIOUS EDITION IS OBSOLETE

*When used as a formal contract this will be the effective date.

REFERENCE AF FORM 616 H93SR232 (Change #1), DATED: 23 MAR 93

1. In accordance with the provisions of the Basic Contract F33615-90-D-4010 and this Delivery Order 0022, the contractor shall accomplish the effort described in the Statement of Work (SOW) dated 16 MAR 93 attached hereto at a total ceiling price of $299,855.00.

2. As a result of paragraph 1 above, the subject order is more specifically modified as set forth below:

SECTION B - THE SCHEDULE:

Item No	Supplies/Services	Quantity Purch Unit	Unit Price Total Item Amt
0001	CLIN sec class: U noun: SAMPLING, ANALYSIS AND DATA acrn: AA nsn: N site codes pqa: D acp: D fob: D pr/mipr data: FY7624-93-08202 type contract: Y descriptive data: Conduct work in accordance with the Statement of Work (SOW) of this order, dated 16 MAR 93 and Section C, The Description/Specifications of the Basic contract. Submit data in accordance with Attachment #1, the Contract Data Requirements List (CDRL) of the basic contract as implemented by paragraph VI of this order's SOW dated 16 MAR 93.	1 LO	N N
0002	CLIN sec class: U noun: SUPPORT acrn: AA nsn: N site codes pqa: D acp: D fob: D pr/mipr data: FY7624-93-08202 type contract: Y descriptive data: Provide support in accordance with the Statement of Work (SOW) of this order, dated 16 MAR 93 and Section C, The Description/Specification of the basic contract.	1	N LO N

3. <u>SECTION C - Description/Specification:</u> - See attached Statement of Work entitled "Installation Restoration Program/Remedial Investigation/Feasibility Study for Distant Early Warning (DEW) line Sites, AK (Barter Island AFS (BAR-M), Bullen Point AFS (POW-3), Point Lonely AFS (POW-1), Point Barrow AFS (POW-M), Point Lay AFS (LIZ-2), Wainwright AFS (LIZ-3), and Oliktok Point AFS (POW-2)" dated 16 MAR 93.

4. <u>SECTION F - Schedule Data:</u>

Item No	Supplies Schedule Data	Delivery Quantity	Schedule Date
0001	CLIN Del Sch acrn: AA ship to: U sec class: U descriptive data: Technical effort shall be completed in accordance with the Statement of Work (SOW) dated 16 MAR 93. All data shall be delivered in accordance with Attachment #1 of the basic contract as implemented by paragraph VI of the Statement of Work dated 16 MAR 93. The data shall be accepted by the Government not later than 31 DEC 93.	1	93DEC31
0002	CLIN Del Sch acrn: AA ship to: U sec class: U descriptive data: Technical effort shall be completed in accordance with the Contract Data Requirements List (Attachment #1) of the basic contract as implemented by paragraph VI of the Statement of Work.	1	93DEC31

1993 March 16

STATEMENT OF WORK
INSTALLATION RESTORATION PROGRAM
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

STAGE 1

DISTANT EARLY WARNING (DEW) LINE SITES and CAPE LISBURNE AFS, AK

I. DESCRIPTION OF WORK

1.1 Scope

1.1.1 **Background.** The objective of the Air Force Installation Restoration Program (IRP) is to assess past hazardous waste disposal and spill sites on Air Force installations and develop remedial actions consistent with the National Contingency Plan (NCP) for those sites which pose a threat to human health and welfare or the environment. This objective is achieved through a Remedial Investigation Feasibility Study (RI/FS) process in which conclusions and recommendations drawn from accurate and validated data are used to structure and guide subsequent activities.

The RI/FS process includes scoping to define data requirements and objectives, a remedial investigation to characterize sites for a baseline risk assessment, and a feasibility study to define and evaluate alternative remedial actions so that a recommended action may be selected. Each of these steps of the RI/FS process can be conducted in stages that focus on particular aspects of the process.

The contractor shall accomplish the actions described in this Statement of Work (SOW) to complete the RI/FS process at the following seven Dew Line Sites and Cape Lisburne:

Barter Island AFS (BAR-M); Bullen Point AFS (POW-3); Point Lonely AFS (POW-1); Point Barrow AFS (POW-M); Point Lay AFS (LIZ-2); Wainwright AFS (LIZ-3); and Oliktok Point AFS (POW-2).

1.1.2 **Requirements for Project Activities.** The Installation Restoration Program (IRP) Handbook referenced in this Statement of Work provides requirements for laboratory and field activities and applicable formats for project documents that shall be used by the contractor. Volume 1 of the Handbook dated May 1992 is provided under separate cover. This document is referenced in this Statement of Work as the Handbook. The contractor is responsible for the thorough knowledge and understanding of the previous findings and recommendations that affect this task prior to the start of field activities. The documents involved include but are not limited to the IRP Phase I Records Search, and the IRP Phase II plans and reports addressing the Dew Line Sites and Cape Lisburne.

1.1.3 **Meetings.** A maximum of two (2) contractor personnel, including the project leader, shall attend four (4) meetings at Elmendorf AFB, AK. Each meeting shall be two (2) 8-hour workdays in duration. All meetings shall be coordinated by the TPM.

1.1.4 **Special Notifications.** The contractor shall immediately report to the TPM, or designate, via telephone, any data or results generated during this investigation which may indicate an imminent health risk. Following this telephone notification, a written notice shall be prepared and

delivered within three (3) days. This notification shall include supporting documentation (sequence 16, para 6.1)

1.2 Project Scoping Documents

The purpose of the project scoping documents is to clearly and comprehensively define project activities prior to the initiation of field work. The contractor shall prepare and submit the following project scoping documents for this task prior to the initiation of any field activities or laboratory analyses.

1.2.1 **Engineering Network Analysis.** Provide within ten (10) days after the issuance of an order a computer generated network analysis which is a detailed task plan for the RI/FS work efforts. The network analysis (GANTT) chart shall be in the form of a progress chart of suitable scale to indicate appropriately the percentage of work scheduled for completion by any given date during the period of the delivery order. The network analysis (GANTT) shall show both serial and parallel subtasks leading to a deliverable product or report, and shall show early and late start and completion dates with float. The network analysis (GANTT) shall be updated and submitted quarterly (sequence 3, para 6.1).

1.2.2 **Work Plan.** This section will discuss the overall approach, (including a brief summary of the Conceptual Site Model and Data Quality Objectives), major tasks, scope, timeline, and major decision points. Due to the extreme remoteness of the Dew Line Sites and Cape Lisburne, the contractor shall include a detailed plan for logistics and strategy to complete the RI/FS field activities. Follow the format specified in section 1 of the Handbook. In preparing the Work Plan, use previous reports and the information gathered during the literature search and presurvey along with experience at similar sites. Reevaluate the recommendations for Dew Line Sites and Cape Lisburne developed during previous IRP stages (sequence 4, para 6.1).

1.2.3 **Sampling and Analysis Plan (SAP).** The SAP consists of a quality assurance plan (QAPP) and a Field Sampling Plan (FSP). Prepare a SAP describing how project activities will be accomplished in the format specified in section 1 of the Handbook. Incorporate review comments and obtain TPM concurrence prior to the start of field activities (sequence 4, para 6.1).

1.2.4 **Health and Safety Plan (HSP).** Provide a written Health and Safety Plan within eight (8) weeks after the issuance of an order. The contractor shall comply with USAF, OSHA, EPA, state, and local health and safety regulations regarding the proposed work effort. Use EPA guidelines for designating the appropriate levels of protection needed at the study sites. The Health and Safety Plan shall provide no less protection than the protection contained in the manual entitled 'Health and Safety Requirements for Employees Engaged in Field Activities' dated 1981 and the 'Occupational Safety and Health Manual for Hazardous Waste Sites Activities' dated 1985 and 29 CFR 1910. Coordinate the Health and Safety Plan directly with applicable regulatory agencies prior to submittal to AFCEE/ESR. The contractor shall certify to AFCEE/ESR that the contractor has reviewed the coordinated Health and Safety Plan with each employee and also subcontractor's employees prior to the time each employee engages in field activities (sequence 4, para 6.1).

1.2.5 **Community Relations Plan.** The contractor shall prepare a Community Relations Plan (CRP) for the DEW Line Sites and Cape Lisburne AFS outlining the specific public communications and involvement techniques to be used in coordination with remedial site activities (sequence 4, para 6.1). Follow the guidance contained in "Community Relations in Superfund, a Handbook", Office of Solid Waste and Emergency Response (OSWER) Directive

9230.0-03C (EPA/540/R-92/009, January 1992, PB92-963341), and other applicable directives. Also, use as a guidance previously accomplished CRP from other installations in Alaska. Appropriately adapt such guidance to the local situation at the DEW Line Sites and Cape Lisburne. As described in OSWER Directive 9230.0-03C, the CRP shall include, but not be limited to, a description of the sites and the community, an overview of the community involvement to date, key community concerns regarding the site and AF site activities, and suggested community relations activities. A contact list of elected officials, agency representatives, and interested groups and individuals shall be included in appropriate copies of the plan. In addition, the plan will include suggested locations for meetings and information repositories. Contractor activities to develop the CRP shall include conducting a review of site information provided by the AF.

1.3 **Project Activities**

The contractor shall conduct the following tasks to achieve the purposes stated herein, in compliance with approved scoping documents, the Handbook, and all applicable regulations and requirements.

1.3.1 Community Relations. Provide support to the base public affairs office for the tasks described below pertaining to the RI/FS Community Relations Program.

1.3.1.1 Public meetings and workshops. The contractor shall be responsible for coordinating public meetings and workshops for all DEW Line Sites and Cape Lisburne AFS. This includes producing briefing scripts, slides and any associated products such as response cards and sign-in sheets. As requested by the base Community Relations office in coordination with the TPM, research and provide materials for public queries, news media queries, and news releases. Assume a maximum of one (1) workshop/meeting (Seq. nos. 3,9).

1.3.1.2 Public notices. As required by the base Community Relations office and the TPM, the contractor shall prepare and publish public notices for the Fairbanks and local newspapers. The purpose of these notices is to inform the public of a meeting, workshop, or comment period in which they have the opportunity to be involved in the IRP Program at DEW Line Sites and Cape Lisburne AFS. Also, these notices may be utilized to inform the public of other pertinent program information such as quarterly notices of documents placed in the information repositories. The format for the notices shall be coordinated with the Community Relations office and TPM, and then submitted to the TPM for review prior to delivery to the base. Assume a maximum of two (2) notices (Seq. no. 3).

1.3.1.3 Photo Notebook The contractor shall develop a photo notebook which focuses on the overall IRP program at DEW Line Sites and Cape Lisburne AFS. The layout of the notebook will be coordinated with the public affairs office and TPM. Assume a maximum of one (1) update (Seq. no. 9).

1.3.1.4 Mailing List. In coordination with the base Community Relations office and the TPM, prepare and update the mailing list on a quarterly basis. Assume a maximum of two (2) updates (Seq. no. 3).

1.3.1.5 Maps. Prepare presentation quality maps of the installations and their sites to use in newsletters and to distribute to the public.

1.3.2 Literature Search. Conduct a literature search and analyze aerial photos of the DEW Line Sties to supplement existing information that has been collected. The purpose of the literature search is to complete the

conceptual site model so that a numerical estimate of risk can be developed.

1.3.3 **Presurvey.** Within eight weeks of the issuance of an order, the contractor shall visit the Dew Line Sites and Cape Lisburne to ensure complete understanding of site conditions. Coordinate this visit with the TPM and the 11 CEOS project manager. The contractor shall look for evidence of contamination at each site visited (e.g., leaking drums, vegetative stress, leachate seeps). The contractor shall observe the physical settings of each site visited to formulate specific recommendations concerning boring placement, use of geophysical techniques, and other aspects of the proposed field investigation. The findings of the presurvey shall be used to prepare the Work Plan, SAP, and HSP for the RI and to prepare scoping documents for the treatability study(ies). Assume one presurvey and one reconnaisance trips.

1.3.4 **Quality Assurance/Quality Control (QA/QC).** A QA/QC program shall be conducted and documented for all work pursuant to this delivery order. Contractor and project-specific documents concerning QA/QC procedures and requirements shall be strictly followed. Data generated under the QA/QC program shall be used by the contractor for evaluating the analytical results and field records assembled for each site to identify accurate and validated data that may be used to assess risk, develop conceptual site models and evaluate alternatives.

1.3.5 **Conceptual Site Model.** Use all available RI/FS data supported by acceptable QA/QC results (as measured against QAPP requirements) and site characterization information to refine, based on newly collected data, the conceptual site model. The model shall define the nature and extent of contamination and the transport and fate of those contaminants. The minimum requirements of the model are given in section 2 of the Handbook. The complexity and detail of the site model shall be consistent with the nature of the site and site problems, and the amount of data available the conceptual site model shall be documented in the Work Plan.

1.3.6 **ARARs Evaluation.** The contractor shall identify all Applicable or Relevant and Appropriate Requirements (ARAR). These ARARs will be documented in the Work Plan.

1.4 Project Deliverables

Deliver the following documents in compliance with the requirements of item VI, the formats required in section 1 and 4 of the Handbook, and the specifications noted below. Draft reports are considered "drafts" only because they have not been reviewed and approved by the Air Force. In all other respects, "drafts" shall be complete, in the proper format, fully illustrated, and free of grammatical and typographical errors.

1.4.1 Scoping Documents.

a. Engineering Network Analysis (GANTT) (para 1.2.1). Provide within ten (10) days after the issuance of an order. Update and submit quarterly (sequence 3, para 6.1).

b. Work Plan (para 1.2.2). Use the format in section 1 of the Handbook (sequence 4, para 6.1).

c. Sampling and Analysis Plan (1.2.3). Use the format in section 1 of the Handbook (sequence 4, para 6.1).

d. Health and Safety Plan (para 1.2.4). Provide within six (6) weeks after the issuance of an order (sequence 4, para 6.1).

e. Community Relations Plan (para 1.2.5). Provide within eight (8) weeks after issuance of an order (sequence 4, para 6.1).

1.4.2 **Special Notification.** Provide written notification of imminent health hazards and supporting documentation within three (3) days of telephone notification (sequence 16, para 6.1).

1.4.3 **Presentation Materials.** The contractor shall prepare and present up to two (2) presentation packages at meetings coordinated by the Air Force (sequence 9, para 6.1). Attendance of these meetings is included in paragraph 1.1.3 of this SOW. As part of the presentation materials, the contractor shall provide paper copies of all slides and overheads.

1.4.4 **Meeting summaries** (para 1.1.3). Provide no later than five (5) days after conclusion of each meeting (sequence 18, para 6.1).

1.4.5 **Newsletter.** Prepare and submit a quarterly newsletter which presents the status of the entire base IRP Program. This will include preparing an outline resulting from input by all contractors involved in the program. The outline must be approved by the base and TPM prior to submittal of the newsletter. The final product will be printed and distributed as agreed to by the TPM. Assume a maximum of two (2) newsletters (Sequence no. 3).

1.4.6 **Fact Sheets.** As required by the base IRP Program, prepare and submit fact sheets which facilitate the public's understanding of the IRP Program. These sheets should include key community concerns regarding sites as specified by the base. Use the format agreed to by the base and TPM. Print and distribute the fact sheets as agreed to by the TPM. Assume a maximum of two (2) fact sheets (Sequence no. 3).

1.4.7 **Public Notices.** In accordance with paragraph 1.3.6.2, prepare and submit public notices for the Fairbanks and local newspapers. Use the format agreed to by the base and TPM (Sequence no. 3).

1.4.8 **Photo Notebook.** In accordance with paragraph 1.3.6.3, develop a photo notebbok which focuses on the overall base IRP Program. Prior to implementation, submit a conceptual layout of the notebook for review by the base and TPM (Sequence no. 9).

1.4.9 **Mailing List.** In accordance with the base Community Relations coordinator and paragraph 1.3.6.4, update the existing mailing list on a quarterly basis (Sequence no. 3).

1.4.10 **Maps.** In accordance with the base community Relations coordinator and paragraph 1.3.6.5, prepare presentation quality maps.

II. Site Location and Dates

Dew Line Sites and Cape Lisburne, date to be established.

III. Base Support The base will:

3.1 Provide the contractor with existing engineering plans, drawings, diagrams, aerial photographs, digitized map files, etc., to facilitate evaluation of IRP sites under investigation.

3.2 Arrange for personnel identification badges, vehicles passes, and/or entry permits with the contention the contractor will provide necessary information to the base personnel no less than four weeks before needed.

3.3 Provide the contractor with all previously approved documents which provide information on all IRP efforts conducted at Dew Line Sites and Cape Lisburne and will aid in the determination of the amount of field work and analyses which need to be conducted.

IV. **Government Furnished Property**

See above in section III.

V. **Government Points of Contact:**

5.1 **MAJCOM Coordinator**

Major James R. Williams III
AFCEE/ESRU
8001 Inner Circle DR STE 2
Brooks AFB TX 78235-5328
(210) 536-5243
DSN 240-5243
(210) 536-9026 FAX
DSN 240-9026

5.2 **Restoration Team Chief**

Mr. Marty M. Faile
AFCEE/ESRU
8001 Inner Circle DR STE 2
Brooks AFB TX 78235-5328
(210) 536-5243
DSN 240-5243
(210) 536-9026 FAX
DSN 240-9026

5.3 **Base Point of Contact (POC)**

Mr. Jim Wolfe
11 CEOS/DEVR
21885 Second Street
Elmendorf AFB AK 99506-4420
(907) 552-4532
DSN 317-552-4532
(907) 552-1533 FAX
DSN 317-552-1533

5.4 **Public Affairs Coordinator**

Ms. Wende Wolf
11 CEOS/DEVR
21885 Second Street
Elmendorf AFB AK 99506-4420
(907) 552-4532
DSN 317-552-4532
(907) 552-1533 FAX
DSN 317-552-1533

DEWSCOPG.DOC

VI. Deliverables

6.1 Attachment 1 of the Basic Contract

Sequence numbers 1 and 5 listed in attachment 1 to the basic contract app. all orders. Guidance for preparing R&D Status Reports (sequence 1) is contained in the Handbook, section 4. In addition, the sequence numbers an dates listed below are applicable to this order:

Sequence No.	Item No.	Block 10 (freq.)	Block 11 (as of date)	Block 12 (date of 1st. submit.)	Block 13 (date of final report)	Block (no. of copies)
3 (NETWORK ANALYSIS)	I.1.4.1a	QTRLY	-	30APR93	a	4
4 (WORK PLAN)	I.1.4.1b	ONE/R	12APR93	30MAY93	30JULY93	b
4 (SAP)	I.1.1.4c	ONE/R	12APR93	30MAY93	30JULY93	b
4 (HSP)	I.1.4.1d	OTTIME	12APR93	30MAY93	-	10
4 (COMM. REL. PLAN)	I.1.1.4e	ONE/R	12APR93	30MAY93	31DEC93	b
16 (SPECIAL NOTIF.)	I.1.4.2	OTTIME	12APR93	c	-	3
9 (PRESNT. MATERIAL)	I.1.4.3	ASREQ	c	d	-	10
18 (MTG. RPTS)	I.1.4.4	ONE/R	d	e	-	5
3 (NEWSLETTER)	I.1.4.5	QTRLY	e	30NOV93	a	5
3 (FACT SHEETS)	I.1.4.6	ASREQ	12APR93	15JUL93	g	-
3 (PUBLIC NOTICES)	I.1.4.7	ASREQ	12APR93	15JUL93	g	[illegible]
9 (PHOTO NOTEBOOK)	I.1.4.8	OTTIME	12APR93	15JUL93	-	-
3 (MAILING LIST)	I.1.4.9	QTRLY	12APR93	15JUL93	a	-
3 (MAPS)	I.1.4.10	OTTIME	12APR93	15JUL93	-	2
			12APR93			

6.2 Reserved.

6.3 Notes

a. Submit Quarterly Thereafter.

b. One (1) first draft plan (8 copies), one (1) second draft plan (8 copies), and one (1) final plan (10 copies) are required. Incorporate Air Force comments into the second draft and final plan as specified by the TPM. Supply AFCEE/ESR with an advance copy of the first draft, second draft, and final plan for acceptance prior to distribution. Distribute the remaining copies of each plan as specified by the TPM. The second and final reports shall be submitted within three (3) weeks of receipt of comments from the TPM.

c. Primary and Secondary Documents. One first draft report (25 copies), one second draft report (25 copies), and one final report (35 bound copies plus the original camera-ready copy and a 3.5 inch disk formatted in WordPerfect 5.1 containing the document file) are required. Incorporate Air Force comments into the second draft and final reports as specified by the TPM. Supply the TPM with an advance copy of the first draft, second draft, and final reports for acceptance prior to distribution. Distribute the remaining copies as specified by the TPM .

d. Provide written notice with supporting documentation within three (3) days of telephone notification and at the direction of the TPM. Assume a maximum of 100 pages.

e. Provide within one (1) week of task/meeting completion.

f. Provide 500 copies of the Newsletters and distribute as agreed to by the TPM. This includes mailing the final product to on-base personnel and addresses on the existing mailing list.

g. Provide draft and final deliverables. Provide two advance copies to the AFCEE TPM and to the 11 CEOS Community Relations Coordinator for acceptance prior to preparation of the final deliverables.

h. Provide poster-size map.

REF 68X 68X

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. PAGE 1 OF 3

2. PROC INSTRUMENT ID NO. (PIIN): F33615-90-D-4010
3. SPIIN: 002201
4. EFFECTIVE DATE:
5. REQUISITION/PURCHASE REQUEST PROJECT NO.: FY7624-93-08305
6. BCC/DMS RATING: --

7. ISSUED BY CODE FQ2826

DEPARTMENT OF THE AIR FORCE
AIR FORCE MATERIEL COMMAND
HUMAN SYSTEMS CENTER/PK
8005 9TH STREET
BROOKS AFB TX 78235-5353
Buyer: EDWIN CUSTODIO/HSC-PKVBA
Phone: (210) 536-4493

8. ADMINISTERED BY (IF OTHER THAN BLOCK 7) CODE S2404A

DCMAO, BALTIMORE
200 TOWNSONTOWN BLVD., WEST
TOWNSON MD 21204-5299

9. CONTRACTOR NAME AND ADDRESS CODE 69148 FACILITY CODE

ICF TECHNOLOGY
9330 LEE HIGHWAY
FAIRFAX VA 22031-1207
COUNTY; FAIRFAX
PHONE: (703) 934-3000

MAIL DATE
JUN 1? 1993

IF "9" FOR MULTIPLE FACILITIES SEE SECT "K"

MAILING ADDRESS;
ICF TECHNOLOGY, INC
ATTN: CYNTHIA L. FALCE
FOUR GATEWAY CENTER 12TH FLOOR
PITTSBURGH PA 15222

10. SECURITY CLAS U

11. DISCOUNT FOR PROMPT PAYMENT

1 ST	%	DAYS	NET DAYS
2 ND	%	DAYS	OTHER IF '9'
3 RD	%	DAYS	SEE SECT "E"

12. PURCHASE OFFICE POINT OF CONTACT: MVH/M6V/MVY

13. THIS BLOCK APPLIES ONLY TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in block 17. The hour and date specified for receipt of Offers ☐ is extended ☐ is not extended

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation, or as amended by one of the following methods:

(a) By signing and returning ______ copies of this amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE ISSUING OFFICE PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

14. THIS BLOCK APPLIES ONLY TO MODIFICATION OF CONTRACTS

☐ THIS CHANGE IS ISSUED PURSUANT TO ______ THE CHANGES SET FORTH HEREIN ARE MADE TO THE ABOVED NUMBERED CONTRACT/ORDER.

☐ THE ABOVE NUMBERED CONTRACT IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (SUCH AS CHANGES IN PAYING OFFICE, APPROPRIATION DATA, ETC.) SET FORTH HEREIN.

☐ THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF ______ IT MODIFIES THE ABOVE NUMBERED CONTRACT AS SET FORTH HEREIN.

☒ THIS MODIFICATION IS ISSUED PURSUANT TO FAR 52.243-3, Changes - Time and Materials or Labor Hours (Aug 1987)

15. CONTRACT ADMINISTRATION DATA

A. KIND OF MOD	B. MOD ABST RECIPIENT ADP PT	C. DATE OF SIGNATURE MODIFICATION	D. CHANGE IN CONTRACT AMOUNT INCREASE (+) DECREASE (-)	E. LOSING PO/CAO ON TRANSFER	F. GAINING PO/CAO ON TRANSFER	G. SVC/AGENCY USE
C			$			

16. ENTER ANY APPLICABLE CHANGES

A. PAY CODE	B. EFFECTIVE DATE OF AWARD	C. CONTRACT (1) TYPE (2) KIND	D. TYPE CONTR	E. SURV CRIT	F. SPL CONTR PROVISIONS	G. PAYING OFC CODE	H. DATE SIGNED	I. SECURITY (1) CLAS (2) DATE OF DD 254
							-	

17. REMARKS (Except as provided herein, all items and conditions of the contract, as heretofore changed, remain unchanged and in full force and effect.) SUBJ: INCREASE IN CEILING AMOUNT

PROJECT OFFICER: MICHAEL F. MCGHEE, AFCEE/ESR, 8001 INNER CIRCLE, SUITE 2, BROOKS AFB, TX 78235-5328
FINANCE OFFICE: (SC1010) DFAS-COLUMBUS CENTER
ATTN: INDEPENDANCE
P.O. BOX 182362, COLUMBUS OHIO 43218-2362

18. ☒ CONTRACTOR/OFFEROR IS NOT REQUIRED TO SIGN THIS DOCUMENT ☐ CONTRACTOR/OFFEROR IS REQUIRED TO SIGN THIS DOCUMENT AND RETURN ______ COPIES TO ISSUING OFFICE

19. CONTRACTOR/OFFEROR (Signature of person authorized to sign)
BY

22. UNITED STATES OF AMERICA (Signature of Contracting Officer)
BY Gary J. Macdecy

20. NAME AND TITLE OF SIGNER (Type or print)

21. DATE SIGNED

23. NAME OF CONTRACTING OFFICER (Type or print): GARY J. MACDECY

24. DATE SIGNED: 93 Jun 16

1. Pursuant to the "Changes" Clause of Section I of the basic contract. The ceiling amount for the order is increased by $99,986. from $299, 855. to $399,841. The performance period remains the same, 31 DEC 93,as a result of this change.

2. As a result of paragraph 1 above, said order is more specifically modified as follows:

a. SECTION A - Cover page - The NTE amount in Block 20 (Cover Page) is increased by $99,986. from $299,855. to $399,841.

b. SECTION B - Supplies and Services - Establish Special ACRN XA.

Item No	Supplies/Services	Quantity Purch Unit	Unit Price Total Item Amt
0001	CLIN Change sec class: U noun: SAMPLING, ANALYSIS, AND DATA acrn: XA nsn: N site codes pqa: D acp: D fob: D type contract: Y		N N
0002	CLIN Change sec class: U noun: SUPPORT acrn: XA nsn: N site codes pqa: D acp: D fob: D type contract: Y		N N

c. SECTION C - Description/Specs/Work Statement - The SOW for this order remains the same as the Basic order entitled, "Installation Restoration Program/Remedial Investigation/Feasibility Study for Distant Early Warning (DEW) Line Sites and Cape Lisburne AFS, AK" dated 16 MAR 93.

d. SECTION F - Supplies Schedule Data - is modified to include ACRN AB and Special ACRN XA.

Item No	Supplies Schedule Data	Delivery Quantity	Schedule Date
0001	CLIN Del Sch Change sec class: U acrn: XA ship to: U	1	93DEC31

0002	CLIN Del Sch Change acrn: XA ship to: U	sec class: U	1	93DEC31

e. SECTION G. - Accounting Classification Data - is amended as set forth below:

ACRN	Acct Class Data	Appropriation/Lmt Subhead/CPN Recip DODAAD Supplemental Accounting Classification	Obligation Amount
AB	ACCOUNT ESTABLISH UNCLASSIFIED	5733400 F74400 303 7434 434419 000007 53440 000000 674400	$99,986.00
	pr/mipr data: FY7624-93-08305		
XA	SPECIAL ACRN ESTABLISH UNCLASSIFIED		

descriptive data:
Special ACRN XA funds CLINs 0001 and 0002 and includes the following:

ACRN AA: $299,855.
AB: $ 99,986.
TOTAL $399,841.

Finance Officer: Pay Funds in Alphabetical Order.

3. This supplemental agreement constitutes full settlement of any claims of the contractor under the contract, including the clause entitled, "Changes", arising out of or in connection with the changes effected hereby.

REF 68X 68X

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. PAGE 1 OF 3

2. PROC INSTRUMENT ID NO. (PIIN)	3. SPIIN	4. EFFECTIVE DATE	5. REQUISITION/PURCHASE REQUEST PROJECT NO.	6. BCC/DMS RATING
F33615-90-D-4010	002202	93JUL23	FY7624-93-08353	--

7. ISSUED BY CODE FQ2826

DEPARTMENT OF THE AIR FORCE
AIR FORCE MATERIEL COMMAND
HUMAN SYSTEMS CENTER/PK
8005 9TH STREET
BROOKS AFB TX 78235-5353
Buyer: REBECCA ROUNSAVILL/PKVBA
Phone: (210) 536-4502

8. ADMINISTERED BY (IF OTHER THAN BLOCK 7) CODE S2404A

DCMAO, BALTIMORE
ATTN: CHESAPEAKE
200 TOWNSONTOWN BLVD, WEST
TOWNSON MD 21204-5299

9. CONTRACTOR CODE 69148 FACILITY CODE
NAME AND ADDRESS
ICF TECHNOLOGY
9330 LEE HIGHWAY
FAIRFAX VA 22031-1207
COUNTY; FAIRFAX
PHONE: (703) 934-3000

IF "9" FOR MULTIPLE FACILITIES SEE SECT "K"

MAIL DATE
JUL 26 1993

MAILING ADDRESS;
ICF TECHNOLOGY, INC
ATTN: CYNTHIA L. FALCE
FOUR GATEWAY CENTER 12TH FLOOR
PITTSBURGH PA 15222

10. SECURITY CLAS U

11. DISCOUNT FOR PROMPT PAYMENT

1 ST	%	DAYS	NET DAYS
2 ND	%	DAYS	OTHER IF "9"
3 RD	%	DAYS	SEE SECT "E"

12. PURCHASE OFFICE POINT OF CONTACT
MVX/M6V/MVY

13. THIS BLOCK APPLIES ONLY TO AMENDMENTS OF SOLITCITATIONS

☐ The above numbered solicitation is amended as set forth in block 17. The hour and date specified for receipt of Offers ☐ is extended ☐ is not extended

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation, or as amended by on of the following methods:

(a) By signing and returning ________ copies of this amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE ISSUING OFFICE PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter provided such telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

14. THIS BLOCK APPLIES ONLY TO MODIFICATION OF CONTRACTS

☐ THIS CHANGE IS ISSUED PURSUANT TO ________ THE CHANGES SET FORTH HEREIN ARE MADE TO THE ABOVED NUMBERED CONTRACT/ORDER.

☐ THE ABOVE NUMBERED CONTRACT IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (SUCH AS CHANGES IN PAYING OFFICE, APPROPRIATION DATA, ETC.) SET FORTH HEREIN.

☐ THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF ________ IT MODIFIES THE ABOVE NUMBERED CONTRACT AS SET FORTH HEREIN.

☒ THIS MODIFICATION IS ISSUED PURSUANT TO FAR 52.253-3, Changes - Time and Materials or Labor Hours. (AUG 1987)

15. CONTRACT ADMINISTRATION DATA

A. KIND OF MOD	B. MOD ABST RECIPIENT ADP PT	C. DATE OF SIGNATURE MODIFICATION	D. CHANGE IN CONTRACT AMOUNT INCREASE (+) DECREASE (-)	E. LOSING PO/CAO ON TRANSFER	F. GAINING PO/CAO ON TRANSFER	G. SVC/AGENCY USE
C			$			

16. ENTER ANY APPLICABLE CHANGES

A. PAY CODE	B. EFFECTIVE DATE OF AWARD	C. CONTRACT (1) TYPE (2) KIND	D. TYPE CONTR	E. SURV CRIT	F. SPL CONTR PROVISIONS	G. PAYING OFC CODE	H. DATE SIGNED	I. SECURITY (1) CLAS (2) DATE OF DD 254

17. REMARKS *(Except as provided herein, all items and conditions of the contract, as heretofore changed, remain unchanged and in full force and effect.)* SUBJ: INCREASE IN CEILING AMOUNT

PROJECT OFFICER: MICHAEL F. MCGHEE, AFCEE/ESR, 8001 INNER CIRCLE, SUITE 2, BROOKS AFB, TX 78235-5328

FINANCE OFFICE: (SC1030) DFAS-COLUMBUS CENTER
ATTN: DFAS-CO/CHESAPEAKE DIVISION
P.O. BOX 182264, COLUMBUS OHIO 43218-2264

18. ☒ CONTRACTOR/OFFEROR IS NOT REQUIRED TO SIGN THIS DOCUMENT ☐ CONTRACTOR/OFFEROR IS REQUIRED TO SIGN THIS DOCUMENT AND RETURN ________ COPIES TO ISSUING OFFICE

19. CONTRACTOR/OFFEROR *(Signature of person authorized to sign)*
BY

22. UNITED STATES OF AMERICA *(Signature of Contracting Officer)*
BY Gary J. Macdecy

20. NAME AND TITLE OF SIGNER *(Type or print)*

21. DATE SIGNED

23. NAME OF CONTRACTING OFFICER *(Type or print)*
GARY J. MACDECY

24. DATE SIGNED
93 Jul 23

AFMC FORM 702, JUL 92 REPLACES AFSC FORM 702, AUG 84 WHICH IS OBSOLETE

REFERENCE: AF Form 616 H93-SR329, DATED: 9 JUL 93; EXPIRES: 15SEP 93; $2,9M

1. Pursuant to the "Changes" Clause of Section I of the basic contract. The ceiling amount for the order is increased by $2,899,511.00 from $399,841.00 to $3,299,352.00. The performance period is changed to 94 Feb 15, as a result of this change.

2. As a result of paragraph 1 above, said order is more specifically modified as follows:

a. SECTION A Cover page - The NTE amount in Block 20 (Cover Page) is increased by $2,899,511.00 from $399,841.00 to $3,299,352.00.

b. SECTION B - Supplies and Services - Establish Special ACRN XA.

Item No	Supplies/Services	Quantity Purch Unit	Unit Price Total Item Amount
0001	CLIN Change sec class: U noun: SAMPLING, ANALYSIS AND DATA acrn: XA nsn: N site codes pqa: D acp: D fob: D type contract: Y		N N
0002	CLIN Change sec class: U noun: SUPPORT acrn: XA nsn: N site codes pqa: D acp: D fob: D type contract: Y		N N
0004	CLIN Establish sec class: U noun: CHEMICAL ANALYSES acrn: XA nsn: N site codes pqa: D acp: D fob: D pr/mirp Data: FY7624-93-08353 type contract: Y	1 LO	N N

c. SECTION C - Description/Specs/Work Statement - The SOW for this order entitled, "Installation Restoration Program Remedial Investigation/Feasibility Study, Stage 1, Distant Early Warning (DEW) Line Sites and Cape Lisburne AFS, AK", dated 6 JUL 93 is attached hereto as Attachment #1 to this modification.

d. SECTION F - Supplies Schedule Data is modified to include ACRN AB and Special ACRN XA.

Item No	Supplies Schedule Data		Delivery Quantity	Schedule Date
0001	CLIN Del Sch Change acrn: XA ship to: U	sec class: U	1	95JANØ1
0002	CLIN Del Sch Change acrn: XA ship to: U	sec class: U	1	95JANØ1
0004	CLIN Del Sch Establish acrn: XA ship to: U	sec class: U	1	95JANØ1

e. SECTION G - Accounting Classification Data - is amended as set forth below:

ACRN	Acct Class data	Appropriation/Lmt Subhead/CPN Recip DODAAD Supplemental Accounting Classification		Obligation Amount
AB	ACCOUNT CHANGE UNCLASSIFIED pr/mipr data:	5733400 303 7434 434419 000007 53440 000000	F74400 674400	$2,899,511.00+
XA	SPECIAL ACRN CHANGE UNCLASSIFIED			

descriptive data:
Special ACRN XA funds CLINs 0001, 0002 and 0004 and includes the following:

ACRN AA:	$ 299,855.00	
AB:	$ 99,986.00	(MOD 0022-01)
	$2,899,511.00	(MOD 0022-02)
TOTAL	$3,299,352.00	

FINANCE OFFICER: Pay funds in alphabetical order.

3. This supplemental agreement constitutes full settlement of any claims of the contractor under the contract, including the clause entitled, "Changes", arising out of or in connecting with the changes effected hereto.

1993 JUL 6

STATEMENT OF WORK
INSTALLATION RESTORATION PROGRAM
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

STAGE 1

DISTANT EARLY WARNING (DEW) LINE SITES and CAPE LISBURNE AFS, AK

I. DESCRIPTION OF WORK

1.1 Scope

1.1.1 **Background.** The objective of the Air Force Installation Restoration Program (IRP) is to assess past hazardous waste disposal and spill sites on Air Force installations and develop remedial actions consistent with the National Contingency Plan (NCP) for those sites which pose a threat to human health and welfare or the environment. This objective is achieved through a Remedial Investigation Feasibility Study (RI/FS) process in which conclusions and recommendations drawn from accurate and validated data are used to structure and guide subsequent activities.

The RI/FS process includes scoping to define data requirements and objectives, a remedial investigation to characterize sites for a baseline risk assessment, and a feasibility study to define and evaluate alternative remedial actions so that a recommended action may be selected. Each of these steps of the RI/FS process can be conducted in stages that focus on particular aspects of the process.

The contractor shall accomplish the actions described in this Statement of Work (SOW) to complete the RI/FS process at the following seven Dew Line Sites and Cape Lisburne:

Barter Island AFS (BAR-M); Bullen Point AFS (POW-3); Point Lonely AFS (POW-1); Point Barrow AFS (POW-M); Point Lay AFS (LIZ-2); Wainwright AFS (LIZ-3); and Oliktok Point AFS (POW-2).

1.1.2 **Requirements for Project Activities.** The Installation Restoration Program (IRP) Handbook referenced in this Statement of Work provides requirements for laboratory and field activities and applicable formats for project documents that shall be used by the contractor. Volume 1 of the Handbook dated May 1992 is provided under separate cover. This document is referenced in this Statement of Work as the Handbook.
The contractor is responsible for the thorough knowledge and understanding of the previous findings and recommendations that affect this task prior to the start of field activities. The documents involved include but are not limited to the IRP Phase I Records Search, and the IRP Phase II plans and reports addressing the Dew Line Sites and Cape Lisburne.

1.1.3 **Meetings.** A maximum of two (2) contractor personnel, including the project leader, shall attend ~~four (4)~~ eight (8) meetings at Elmendorf AFB, AK. Each meeting shall be two (2) 8-hour workdays in duration. All meetings shall be coordinated by the Restoration Team Chief (RTC).

1.1.4 **Special Notifications.** The contractor shall immediately report to the RTC, or designate, via telephone, any data or results generated during this investigation which may indicate an imminent health risk. Following this telephone notification, a written notice shall be prepared and

delivered within three (3) days. This notification shall include supporting documentation (sequence 16, para 6.1)

1.2 Project Scoping Documents

The purpose of the project scoping documents is to clearly and comprehensively define project activities prior to the initiation of field work. The contractor shall prepare and submit the following project scoping documents for this task prior to the initiation of any field activities or laboratory analyses.

1.2.1 **Engineering Network Analysis.** Provide within ten (10) days after the issuance of an order a computer generated network analysis which is a detailed task plan for the RI/FS work efforts. The network analysis (GANTT) chart shall be in the form of a progress chart of suitable scale to indicate appropriately the percentage of work scheduled for completion by any given date during the period of the delivery order. The network analysis (GANTT) shall show both serial and parallel subtasks leading to a deliverable product or report, and shall show early and late start and completion dates with float. The network analysis (GANTT) shall be updated and submitted quarterly (sequence 3, para 6.1).

1.2.2 **Work Plan.** This section will discuss the overall approach, (including a brief summary of the Conceptual Site Model and Data Quality Objectives), major tasks, scope, timeline, and major decision points. Due to the extreme remoteness of the Dew Line Sites and Cape Lisburne, the contractor shall include a detailed plan for logistics and strategy to complete the RI/FS field activities. Follow the format specified in section 1 of the Handbook. In preparing the Work Plan, use previous reports and the information gathered during the literature search and presurvey along with experience at similar sites. Reevaluate the recommendations for Dew Line Sites and Cape Lisburne developed during previous IRP stages (sequence 4, para 6.1).

1.2.3 **Sampling and Analysis Plan (SAP).** The SAP consists of a quality assurance plan (QAPP) and a Field Sampling Plan (FSP). Prepare a SAP describing how project activities will be accomplished in the format specified in section 1 of the Handbook. Incorporate review comments and obtain RTC concurrence prior to the start of field activities (sequence 4, para 6.1).

1.2.4 **Health and Safety Plan (HSP).** Provide a written Health and Safety Plan within eight (8) weeks after the issuance of an order. The contractor shall comply with USAF, OSHA, EPA, state, and local health and safety regulations regarding the proposed work effort. Use EPA guidelines for designating the appropriate levels of protection needed at the study sites. The Health and Safety Plan shall provide no less protection than the protection contained in the manual entitled "Health and Safety Requirements for Employees Engaged in Field Activities" dated 1981 and the "Occupational Safety and Health Manual for Hazardous Waste Sites Activities" dated 1985 and 29 CFR 1910. Coordinate the Health and Safety Plan directly with applicable regulatory agencies prior to submittal to AFCEE/ESR. The contractor shall certify to AFCEE/ESR that the contractor has reviewed the coordinated Health and Safety Plan with each employee and also subcontractor's employees prior to the time each employee engages in field activities (sequence 4, para 6.1).

1.2.5 **Community Relations Plan.** The contractor shall prepare a Community Relations Plan (CRP) for the DEW Line Sites and Cape Lisburne AFS outlining the specific public communications and involvement techniques to be used in coordination with remedial site activities (sequence 4, para 6.1). Follow the guidance contained in "Community Relations in Superfund, a Handbook", office of Solid Waste and Emergency Response (OSWER) Directive

9230.0-03C (EPA/540/R-92/009, January 1992, PB92-963341), and other applicable directives. Also, use as a guidance previously accomplished CRP from other installations in Alaska. Appropriately adapt such guidance to the local situation at the DEW Line Sites and Cape Lisburne. As described in OSWER Directive 9230.0-03C, the CRP shall include, but not be limited to, a description of the sites and the community, an overview of the community involvement to date, key community concerns regarding the site and AF site activities, and suggested community relations activities. A contact list of elected officials, agency representatives, and interested groups and individuals shall be included in appropriate copies of the plan. In addition, the plan will include suggested locations for meetings and information repositories. Contractor activities to develop the CRP shall include conducting a review of site information provided by the AF.

1.3 Project Activities

The contractor shall conduct the following tasks to achieve the purposes stated herein, in compliance with approved scoping documents, the Handbook, and all applicable regulations and requirements.

1.3.1 **Community Relations.** Provide support to the base public affairs office for the tasks described below pertaining to the RI/FS Community Relations Program.

1.3.1.1 Public meetings and workshops. The contractor shall be responsible for coordinating public meetings and workshops for all DEW Line Sites and Cape Lisburne AFS. This includes producing briefing scripts, slides and any associated products such as response cards and sign-in sheets. As requested by the base Community Relations office in coordination with the RTC, research and provide materials for public queries, news media queries, and news releases. Assume a maximum of one (1) workshop/meeting (Seq. nos. 3,9).

1.3.1.2 Public notices. As required by the base Community Relations office and the RTC, the contractor shall prepare and publish public notices for the Fairbanks and local newspapers. The purpose of these notices is to inform the public of a meeting, workshop, or comment period in which they have the opportunity to be involved in the IRP Program at DEW Line Sites and Cape Lisburne AFS. Also, these notices may be utilized to inform the public of other pertinent program information such as quarterly notices of documents placed in the information repositories. The format for the notices shall be coordinated with the Community Relations office and RTC, and then submitted to the RTC for review prior to delivery to the base. Assume a maximum of two (2) notices (Seq. no. 3).

1.3.1.3 Photo Notebook. The contractor shall develop a photo notebook which focuses on the overall IRP program at DEW Line Sites and Cape Lisburne AFS. The layout of the notebook will be coordinated with the public affairs office and RTC. Assume a maximum of one (1) update (Seq. no. 9).

1.3.1.4 Mailing List. In coordination with the base Community Relations office and the RTC, prepare and update the mailing list on a quarterly basis. Assume a maximum of two (2) updates (Seq. no. 3).

1.3.1.5 Maps. Prepare presentation quality maps of the installations and their sites to use in newsletters and to distribute to the public.

1.3.1.6 Information Repository/Administrative Record. Prepare a listing of all documents required for the Information Repository and Administrative Record. Create an Informatin Repository and Administrative Record. The Reporsitory and Record will be maintained by the 11 CEOS/CEVR Community Relations Coordinator. Assume two locations for the Repository and Record, one in Anchorage and another in Elmendorf AFB, AK. Actual locations will be determined by the 11 CEOS/CEVR Community Relations Coordinator.

1.3.2 **Literature Search.** Conduct a literature search and analyze aerial photos of the DEW Line Sties to supplement existing information that has been collected. The purpose of the literature search is to complete the conceptual site model so that a numerical estimate of risk can be developed.

1.3.3 **Presurvey.** Within eight weeks of the issuance of an order, the contractor shall visit the Dew Line Sites and Cape Lisburne to ensure complete understanding of site conditions. Coordinate this visit with the RTC and the 11 CEOS project manager. The contractor shall look for evidence of contamination at each site visited (e.g., leaking drums, vegetative stress, leachate seeps). The contractor shall observe the physical settings of each site visited to formulate specific recommendations concerning boring placement, use of geophysical techniques, and other aspects of the proposed field investigation. The findings of the presurvey shall be used to prepare the Work Plan, SAP, and HSP for the RI and to prepare scoping documents for the treatability study(ies). Assume one presurvey and one reconnaisance trips.

1.3.4 **Quality Assurance/Quality Control (QA/QC).** A QA/QC program shall be conducted and documented for all work pursuant to this delivery order. Contractor and project-specific documents concerning QA/QC procedures and requirements shall be strictly followed. Data generated under the QA/QC program shall be used by the contractor for evaluating the analytical results and field records assembled for each site to identify accurate and validated data that may be used to assess risk, develop conceptual site models and evaluate alternatives.

1.3.5 **Conceptual Site Model.** Use all available RI/FS data supported by acceptable QA/QC results (as measured against QAPP requirements) and site characterization information to refine, based on newly collected data, the conceptual site model. The model shall define the nature and extent of contamination and the transport and fate of those contaminants. The minimum requirements of the model are given in section 2 of the Handbook. The complexity and detail of the site model shall be consistent with the nature of the site and site problems, and the amount of data available the conceptual site model shall be documented in the Work Plan.

1.3.6 **ARARs Evaluation.** The contractor shall identify all Applicable or Relevant and Appropriate Requirements (ARAR). These ARARs will be documented in the Work Plan.

1.3.7 **Data Collection, Sampling, and Analysis Procedures.** The contractor shall conduct field activities, sampling, laboratory analysis, and data quality assessment. Section 2 of the Handbook is recommended for the contractor to follow. The contractor shall conduct all activities in accordance with the WP and the SAP approved by the COR. The COR shall be notified in writing of any planned deviation from the activities specified in these documents. COR approval of deviations is required prior to performance.

The field investigation (including all drilling and sampling operations) shall be supervised by a registered geologist, hydrogeologist, or professional engineer. If required by the state, the on-site field supervisor shall be

certified by the state to install test wells. A detailed log of field conditions, materials penetrated during drilling, well completion, and sampling conditions, as described in Section 2 of the Handbook, shall be maintained and made available for Government inspection upon request. Decisions on well and boring locations, well depths, screened intervals, and all details of the field investigation shall be made by the COR, and the contractor's field or project supervisor.

1.3.8 **Regulatory Requirements and Permits.** All well drilling, development , sampling, laboratory analysis, and other activities pursuant to this effort shall be conducted in strict accordance with all applicable federal and state laws, ordinances, rules and regulations, and all authorities with jurisdiction over such activities. The contractor shall complete permits, applications, other documents, and proficiency tests required by the regulatory agencies. The contractor shall file documents with appropriate agencies and pay all applicable permit and filing fees. The contractor shall identify locations requiring permits to Radar Station Manager. The contractor shall include all correspondence in appendices to the technical reports in accordance with Section 4 of the Handbook.

All laboratory analyses shall conform to all applicable federal, state, and local regulatory agency requirements. If the requirements specify that certification is necessary to conduct one or more specific analyses, the contractor shall furnish documentation showing laboratory certification with the first set of analytical data supplied to AFCEE/ESR and the COR.

The contractor shall containerize and sample materials suspected to be hazardous in accordance with applicable requirements, Guidance from the Handbook, and the approved Plans. The contractor shall transport these containerized materials to a location within the installation boundary designated by the Radar Station Manager at a frequency specified by the Station Manager. The contractor shall handle, store, and/or dispose of potentially hazardous materials. The contractor shall transport and empty containerized materials determined not to be hazardous to locations within the installation boundary identified by the Station Manager.

1.3.9 **Remedial Investigation (RI).** The contractor shall conduct a RI to characterize environmental conditions; define the concentration, nature, and extent of contamination; and quantitatively estimate the risk to human health and the environment and study the area through the collection of geologic and hydrologic data, environmental samples, the laboratory analyses of those samples for potential contaminants, the evaluation of the analytical results and field measurements with respect to quality control data, and the interpretation and analysis of accurate and precise data. The purpose of data collection, sample collection, and laboratory analysis is to determine whether any contaminants generated from installation activities have entered the environment. The field investigation is used to determine the source of any identified contaminants, the magnitude of contamination relative to Applicable or Relevant and Appropriate Requirements (ARARs), and any naturally occurring or background concentrations for specific compounds. The RI shall comply with the specifications, procedures, and methodologies presented in the project-specific SAP. The COR must be notified in writing prior to any modification of or deviation from any activity described in these documents.

1.3.9.1 **Soil Borehole Drilling and Sampling and Well Installation and Sampling.** The contractor shall drill and collect samples from boreholes as specified in the SAP. The contractor shall evaluate the need to install, sample, and develop monitoring or extraction wells.

1.3.9.1.1 **Lithologic Samples.** The contractor shall describe core samples at least every five (5) feet of drilling or at each change in lithology, whichever is less, to indicate significant changes in lithology of characteristic properties that relate to the strata penetrated. Any deviations shall be coordinated with the COR. Guidance for standard identification practices are found in the Handbook. The contractor shall include in the field logbook observations made by the driller and rig geologist during drilling such as depth to water, penetration rate, drill rig behavior, and other observations that might be indicative of changes in formation characteristics. The contractor shall record depth to permafrost in all the soil borings and shall not proceed beyond five (5) feet into the permafrost layer.

1.3.9.1.2 **Drill Cuttings and Drilling Fluids.** The contractor shall containerize all drill cuttings and drilling fluids. All drill cuttings and drilling fluids shall be managed and disposed of in accordance with the project SAP. (Note: The contractor shall be responsible for providing all necessary containers.) The contractor shall be responsible for the logistics of the ultimate disposal of all drill fluids or drill cuttings deemed hazardous in accordance with current EPA off-site disposal policy and state and/or local hazardous waste disposal laws. The contrator shall coordinate with the Station Manager for on-site placement and disposal of all drill cuttings, fluids, purge fluid, and excavated material. If on-site disposal is excluded, all hazardous waste shall be transported by a permitted hazardous waste transporter to a licensed Resource Conservation and Recovery Act (RCRA) approved facility and be accompanied by a Uniform Hazardous Waste Manifest. The contractor shall provide a final, completed copy of the hazardous waste manifest to the 11 CEOS/CEVR. The Radar Stations' hazardous waste managers will sign all hazardous waste manifest documents.

1.3.9.1.3 **Well/Boring Precautions.** The contractor shall mark the field locations of all borings during the planning/mobilization phase of the field investigation. The contractor shall consult with base personnel to minimize the disruption of base activities, to properly position wells with respect to site locations, and to avoid penetrating underground utilities. The contractor shall obtain all permits prior to commencement of digging and drilling operations. The contractor shall utilize a registered land surveyor in determining the elevations and locations of all off-base background study borings. All borings and wells from which samples are taken shall be surveyed by the contractor for vertical and horizontal control. The contractor shall record the positions on project and site specific maps. Bench marks used must have been previously established from and be traceable to a U. S. Coast and Geodetic Survey (USCGS) or U. S. Geological Survey (USGS) survey marker. Clearly identify all bench mark locations on the base map.

1.3.9.1.4 **Water-Level Measurements in Boreholes.** The contractor shall measure water levels in all boreholes after the water level has stabilized. Include this information and the date of measurement in the boring logs. Also, record soil moisture conditions (moist, wet, saturated, etc.) in the boring log.

1.3.9.1.5 **Air Monitoring During Drilling.** The contractor shall monitor the ambient air in the breathing zone above the borehole during all drilling with an appropriate organic vapor analyzer to identify potentially hazardous and/or toxic vapors. Include air monitoring results in borehole logs.

1.3.9.1.6 **Subsurface Soil Sampling.** The contractor shall collect soil samples from borings as specified in the SAP. The SAP specifies the analytical methods, the parameters for analysis, and the estimated number of analyses for soil samples.

1.3.9.1.7 **Well Construction Requirements.** The contractor shall coordinate with the COR to determine well completion requirements (flush or projected above ground surface). All wells shall be secured as soon as possible after drilling. The contractor shall provide corrosion resistant locks for both flush and above-ground well assemblies. The locks shall be compatible with existing wells. The contractor shall turn the lock keys over to 11 CEOS/CEVR POC following completion of the field effort. The contractor shall coordinate with the 11 CEOS/CEVR POC, the RTC, and the COR the selection of exact well and screen placement, gravel pack design, and screen slot size.

1.3.9.1.8 **Well Logs.** For each well, the contractor shall prepare a well completion log and schematic diagram showing well construction details. Lithologic descriptions, well elevation survey data, and other information included in the well logs shall conform to the specifications of the SAP.

1.3.9.1.9 **Well Development.** The contrator shall develop each well as soon as possible. Guidance for well development procedures are found in the the Handbook. The contractor shall measure the rate of water production, pH, specific conductance, and water temperature during well development.

1.3.9.1.10 **Well Placement.** The contractor shall avoid installing wells in depressions or areas subject to frequent flooding and/or standing water. If wells must be installed in such areas, the contractor shall design the wells so standing water does not leak into the top of the casing or cascade down the annular space.

1.3.9.1.11 **Well and Borehole Clean-up.** The contractor shall clean the area following the completion of each well and borehole. The contractor shall return all sites to the original condition of the site.

1.3.9.1.12 **Groundwater and Surface Water Sampling.** The contractor shall collect groundwater and Surface Water samples from newly developed well and existing wells and from surface water bodies. The SAP shall specify the analytical methods, the parameters for analysis, and the estimated number of analyses for groundwater and surface water samples.

1.3.9.1.13 **Composite Sampling.** The contractor shall collect and analyze drill cuttings, fluids, purge fluids, and excavated material. The SAP shall specify the analytical methods, the parameters for analysis, and the estimated number of analyses for composite samples.

1.3.9.2 **Geophysical Surveys.** The contractor shall evaluate whether geophysical surveys are needed (e.g., to determine boundaries of landfills, to locate underground debris, utilities and storage tanks). Where geophysical surveys are appropriate, the contractor shall select a geophysical survey technique or techniques [such as ground penetrating radar (GPR), magnetometer or electromagnetic surveys (EM)] that will best meet the desired application. The technique(s) used shall be approved by the RTC prior to use. Approximate number of surveying days is included in Annex A which is to be used for costing purposes only. Appropriate grid systems shall be established and the contractor shall use the results of this survey to prepare a contour map of the results. Provide this map as an attachment to the first R&D Status Report

submitted after the completion of the geophysical surveys. The contractor shall perform the geophysical surveys before drilling and use the results in selecting the location of soil borings, wells, test pits, if necessary.

1.3.9.3 **Permeability Testing.** The contractor shall determine the need for a permeability test at Cape Lisburne AFS, to provide additional data on the hydrogeologic characteristics of the water table aquifer. The SAP shall specify the method to be used for the permeability test.

1.3.9.4 **Water Level Measurement.** The contractor shall evaluate the need for conducting a complete round of water level measurements in all existing and new wells at Cape Lisburne AFS at the beginning of field work and during the field sampling effort. Data gathered shall be used for interpreting groundwater flow directions and groundwater gradient.

1.3.9.5 **Soil Gas Surveys.** The contractor shall evaluate the need for soil gas surveys and Hydropunch (e.g., to select soil boring locations). If soil gas surveys and hydropunch are included as part of the approved Work Plan and FSP, the contractor shall establish appropriate grid systems. The contractor shall prepare a posting map of soil gas values relative to their location on the grid used. Provide this map as an attachment to the first R&D Status Report submitted after completion of the soil gas survey (sequence 3, para 6.1). Approximate number of surveying days are included in Annex A which is to be used for costing purposes only.

1.3.9.6 **Groundwater Field Screening.** The contractor shall perform groundwater field screening. The SAP shall specify the method, location, and type of groundwater field screening.

1.3.9.7 **Baseline Risk Assessment.** The contractor shall use data supported by acceptable QA/QC results (as measured against QAPP requirements) and the conceptual site model to numerically estimate the risk posed by site contaminants to human health and the environment. The contractor shall identify and list all ARARs for those contaminants detected in environmental samples at the site. The contractor shall provide all ARARs evaluations as an attachment to the Technical Report. Provide the results of the baseline risk assessment in the Technical Report using the formats in Section 4 of the Handbook as a guidance.

The contractor shall identify those sites posing minimal or no threat to human health, welfare, or the environment and for which no further action is appropriate.

The contractor shall use the results of the risk assessment in establishing remedial action objectives and developing remedial alternatives in the Feasibility Study.

1.3.9.8 **Defense Priority Model Scores.** The contractor shall use the Defense Priority Model to score the sites. The score shall be included as an appendix to the RI/FS Technical Report.

1.3.9.9 **Fate and Transport.** The contractor shall perform fate and transport modeling for contaminants of interest to include the projection of future contaminant concentrations within the boundaries of the site. This will be done in conjunction with the RI/FS report.

1.3.13 **Weekly Field Activity Report**

The contractor shall transmit a Weekly field activity report. The AFCEE RTC shall develop the format for the report.

1.4 **Project Deliverables**

Deliver the following documents in compliance with the requirements of item VI, the formats required in section 1 and 4 of the Handbook, and the specifications noted below. Draft reports are considered "drafts" only because they have not been reviewed and approved by the Air Force. In all other respects, "drafts" shall be complete, in the proper format, fully illustrated, and free of grammatical and typographical errors.

1.4.1 **Scoping Documents.**

a. Engineering Network Analysis (GANTT) (para 1.2.1). Provide within ten (10) days after the issuance of an order. Update and submit quarterly (sequence 3, para 6.1).

b. Work Plan (para 1.2.2). Use the format in section 1 of the Handbook (sequence 4, para 6.1).

c. Sampling and Analysis Plan (1.2.3). Use the format in section 1 of the Handbook (sequence 4, para 6.1).

d. Health and Safety Plan (para 1.2.4). Provide within six (6) weeks after the issuance of an order (sequence 4, para 6.1).

e. Community Relations Plan (para 1.2.5). Provide within eight (8) weeks after issuance of an order (sequence 4, para 6.1).

1.4.2 **Special Notification.** Provide written notification of imminent health hazards and supporting documentation within three (3) days of telephone notification (sequence 16, para 6.1).

1.4.3 **Presentation Materials.** The contractor shall prepare and present up to two (2) presentation packages at meetings coordinated by the Air Force (sequence 9, para 6.1). Attendance of these meetings is included in paragraph 1.1.3 of this SOW. As part of the presentation materials, the contractor shall provide paper copies of all slides and overheads.

1.4.4 **Meeting Summaries** (para 1.1.3). Provide no later than five (5) days after conclusion of each meeting (sequence 18, para 6.1).

1.4.5 **Newsletter.** Prepare and submit a quarterly newsletter which presents the status of the entire base IRP Program. This will include preparing an outline resulting from input by all contractors involved in the program. The outline must be approved by the base and RTC prior to submittal of the newsletter. The final product will be printed and distributed as agreed to by the RTC. Assume a maximum of two (2) newsletters (Sequence no. 3).

1.3.10 **Feasibility Study (FS).** The contractor shall perform a FS concurrently with the RI. As much of the FS as possible shall be performed early in the RI/FS process and refined as additional RI data are obtained. The contractor shall use the information from the RI and the baseline risk assessment to develop and evaluate remedial action alternatives for each site where a threat to human health or the environment exists. The contractor shall follow the procedures specified in USEPA OSWER Directive 9355.3-01, "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA." The contractor shall employ streamlining methods wherever possible and develop and evaluate the minimum number of alternatives needed to provide a range of promising treatment and containment actions. The contractor shall eliminate impracticable alternatives from further consideration early in the FS process. The scope and level of detail shall be consistent with the nature and complexity of site problems.

1.3.10.1 **Develop and Screen Alternatives.** The contractor shall establish remedial action objectives and remediation goals for protecting human health and the environment. These objectives and goals shall be determined based on identified ARARs and acceptable exposure levels as defined in the baseline risk assessment and refined throughout the RI/FS process. Identify general response actions and applicable technologies based on site and contaminant conditions, and combine technologies to formulate distinct alternatives. The contractor shall develop alternatives which eliminate, control, and /or reduce risk to human health or the environment to acceptable levels for each pathway. Where a wide variety of promising alternatives exists, the contractor shall screen the alternatives based on effectiveness, implementability, and cost. The contractor shall detail the development and screening of the alternatives process and identify the alternatives selected for detailed analysis in the Informal Technical Information Report (ITIR).

1.3.10.2 **Detailed Screening of Alternatives.** The contractor shall conduct a detailed analysis on each alternative selected and identified in the above step and approved by the COR. Using the methodology in OSWER Directive 9355.3-01, the contractor shall evaluate each alternative against the nine criteria. In addition to the individual assessment, the contractor shall perform a comparative analysis to determine the relative performance of alternatives. The contractor shall focus the analysis on sub-factors and criteria most pertinent to each site and the scope and complexity of the proposed action. Provide a summary of the Detailed Analysis of Alternatives in the R&D report submitted following task completion. Include summary tables of the individual and comparative analyses that will be used in the Technical Report.

1.3.11 **Desicion Documents.** The contractor shall prepare and submit Decision Documents (DD) following the Handbook Section 4.4 as guidance. The purpose of the DD is to support a remedial action alternative or a no further action alternative.

1.3.12 **Site Specific Requirements.** The contractor shall perform the requirements listed in this SOW in conformance with the guidance of the Handbook, requirements of the approved WP, and the SAP. Annex A specifies the proposed values for field and laboratory activities to be conducted, specifications for field activities, information for sediment and soil samples, analytical methods, parameters for analysis, estimated number of analyses for water/sediment/soil samples, required analytical methods, estimated number of analyses for all core samples, estimated number soil gas analyses for each parameter, and field QC sample requirements for soil and water samples for costing purposes only.

1.4.6 **Fact Sheets.** As required by the base IRP Program, prepare and submit fact sheets which facilitate the public's understanding of the IRP Program. These sheets should include key community concerns regarding sites as specified by the base. Use the format agreed to by the base and RTC. Print and distribute the fact sheets as agreed to by the RTC. Assume a maximum of two (2) fact sheets (Sequence no. 3).

1.4.7 **Public Notices.** In accordance with paragraph 1.3.6.2, prepare and submit public notices for the Fairbanks and local newspapers. Use the format agreed to by the base and RTC (Sequence no. 3).

1.4.8 **Photo Notebook.** In accordance with paragraph 1.3.6.3, develop a photo notebbok which focuses on the overall base IRP Program. Prior to implementation, submit a conceptual layout of the notebook for review by the base and RTC (Sequence no. 9).

1.4.9 **Mailing List.** In accordance with the base Community Relations coordinator and paragraph 1.3.6.4, update the existing mailing list on a quarterly basis (Sequence no. 3).

1.4.10 **Maps.** In accordance with the base community Relations coordinator and paragraph 1.3.6.5, prepare presentation quality maps.

1.4.11 **Information Repository/Administrative Records.** Submit the Information Repository and Administrative Records in accordance with Air Force Guidance and in concurrance with the COR and the base Community Relations Coordinator. (sequence no. 4, para 6.1)

1.4.12 **Data Management.** The contractor shall meet the data deliverable requirements of the Installation Restoration Program Information Management System (IRPIMS). The contractor shall be responsible for recording field and laboratory data into a computerized format as required by the most current version of the IRPIMS Data Loading Handbook (mailed under separate cover). In order to perform this task, the contractor shall use the IRPIMS Quality Control Tool (QC Tool) and PC software utility (mailed under separate cover with software manual) to quality check ASCII data files and to check all data files for compliance with requirements in the IRPIMS Data Loading Handbook. Upon request, the IRPIMS Contractor Data Loading Tool (CDLT) is available. This PC software is designed to assist the contractor in preparing the various ASCII data files.

Individual IRPIMS data files (e.g., analytical results, groundwater level data, etc.), including resubmissions, shall be delivered with a transmittal letter by the contractor to the Air Force Center for Environmental Excellence (AFCEE) in sequence according to a controlled time schedule as identified in the current version of the IRPIMS Data Loading Handbook. The contractor shall include a copy of the Quality Control Tool error report, i.e., output from the QC tool, for each IRPIMS file submission. The error report shall be submitted both in hard copy and as an electronic file on the submission disks with the filename of the error report identified in the transmittal letter (SEQUENCE No. 3).

All contractor data deliverables shall be sent to:

AFCEE/ESD BLDG 624W
ENVIRONMENTAL RESTORATION DIVISION
ATTN: IRPIMS Data Management
Brooks AFB, TX 78235-5000

In addition, the contractor shall provide a copy of the transmittal letter to the Air Force contracting office responsible for the contract, HSC/PKV (Brooks AFB, TX, 78235-5000) for AFCEE contracts. This letter shall identify the files included or otherwise omitted (with an appropriate explanation), the Government contract and delivery order number, and the Air Force POC that is responsible for monitoring the Government contract.

The contractor shall be responsible for the accuracy and completeness of all data submitted. All data entered into the IRPIMS data files and submitted by the contractor shall correspond exactly with the data contained in the original laboratory reports and other documents associated with sampling and laboratory contractual tasks.

Each file delivered by the contractor will be electronically evaluated by AFCEE/ESD for format compliance and data integrity in order to verify acceptance. All files delivered by the contractor are required to be error-free and in compliance with the IRPIMS Data Loading Handbook. Any errors identified by AFCEE/ESD in the submission shall be corrected by the contractor.

1.4.13 **Decision Document.** The contractor shall prepare and submit DD as described in Section 1.3.11 (SEQUENCE No. 4, para 6.1).

1.4.14 **Technical Reports.** Summarize the findings of the tasks pursuant to the SOW, integrate them with the results of all pertinent previous studies, and formulate conclusions and recommendations for future efforts in Technical Reports.

1.4.14.1. **Remedial Investigation (RI) Report** (para 1.3.3). Provide a RI Report following the format in section 4 of the Handbook (sequence 4, para 6.1).

1.4.14.2. **Risk Assessment (RA) Report** (para 1.3.3.7). Provide a RA Report following the format in section 4 of the Handbook (sequence 4, para 6.1).

1.4.14.3 **Feasibility Study Report** (para 1.3.4). Provide a Feadsibility Study Report foillowing the format in section 4.0 of the Handbook. (sequence 4, para 6.1).

1.4.14.4 **RI/FS Technical Report** (para 1.3.3). Provide a RI/FS Technical Report following the format in section 4.0 of the Handbook. The RI/FS Technical Report shall integrate the RI, RA, and FS reports. Provide two microfiche copies with the final RI/FS Technical Report (sequence 4, para 6.1).

1.4.15 **Basewide Comprehensive IRP Document.** The contractor shall develop a comprehensive document that summarizes both the historic and projected IRP activities. This document shall be used as managment tool to efficiently guide future IRP activities at the DEW Line Sites and Cape Lisburne AFS. The contractor shall follow the outline developed by the AFCEE RTC. Assume two (2) updates (sequence no. 4)

1.4.16 **Analytical Data ITIR.** Prepare and submit the following ITIR's:

a. Development & Screening of Alternatives (para. 1.3.10.1). Submit the results of the development and screening of alternatives in an ITIR prepared in compliance with section 3 of the Handbook (sequence 3, para 6.1)

b. Detailed Screening of Alternatives (para 1.3.10.2).

c. DPM Scoring (para 1.3.9.8). Provide scores, a summary of procedures and assumptions, and Automated DPM output tables for all sites scored with DPM (sequence 3, para 6.1).

d. Mylar[R] Map. Construct Radar Stations' maps of Mylar using guidelines in section 3 of the Handbook. The Maps shall contain all sites and related water and sediment sampling locations (sequence no.3, para. 6.1). The contractor shall create and update digitized map files. Use the digitized data file to produce the Mylar map. The contractor shall print the revision date on the Mylar maps and the date shall be encoded in the digitized data file. Provide a copy of the revised digitized data file to AFCEE-ESO/ER (sequence 1, para. 6.2).

e. Geophysical Survey Contour Map (para 1.3.9.2). Provide a contour map showing geophysical survey results. Interpret the significance of the data in the R&D Status Report (sequence 3, para 6.1).

f. Soil Gas Map (para 1.3.9.5). Provide site maps showing soil gas data superimposed on the sampling locations and incorporate soil gas data generated by the 11 CEOS/CEOR. Interpret the significance of the data in the R&D Status Report (sequence 3, para 6.1).

g. Site Characterization Summary Informal Technical Information Report (SCS ITIR). The contractor shall prepare the report to include the following components:

1. Source identification and contaminant delineation.

2. Identification and ranking of appropriate treatability studies for the listed sites.

3. Data and interpretations integrating the findings of the current study and all previous RI efforts at the sites.

4. Current isoconcentration plots of contaminants detected at each site, lithologic logs of each boring showing contaminants detected and relationship to other borings in the site, and cross-sections of the site showing contaminant distribution.

5. The contents and objectives of a Site Characterization Summary Informal Technical Information Report (ITIR) are specified in the Handbook. The Site Characterization Summary ITIR shall serve as a core document for the RI report. The contractor shall submit an annotated outline of each section of the ITIR for approval by the TPM prior to preparation of the report itself. The contractor shall prepare the report as specified in the accepted annotated outline. The contractor shall submit newly revised portions of the working draft ITIR in order to make available current site characterization data. A prime objective shall be to minimize the volume of comments on the working draft and final submittals by incorporating comments into the report in an on-going manner. The final summary shall contain all sites included in this effort (Sequence No. 4).

h. Weekly Field Activities Report (para 1.3.13). Transmit a Weekly field activities report during field activities pursuant to a format developed by the AFCEE RTC. (Seqence 4, para 6.1)

II. Site Location and Dates

Dew Line Sites and Cape Lisburne, date to be established.

III. Base Support The base will:

3.1 Provide the contractor with existing engineering plans, drawings, diagrams, aerial photographs, digitized map files, etc., to facilitate evaluation of IRP sites under investigation.

3.2 Arrange for personnel identification badges, vehicles passes, and/or entry permits with the contention the contractor will provide necessary information to the base personnel no less than four weeks before needed.

3.3 Provide the contractor with all previously approved documents which provide information on all IRP efforts conducted at Dew Line Sites and Cape Lisburne and will aid in the determination of the amount of field work and analyses which need to be conducted.

IV. Government Furnished Property

See above in section III.

V. **Government Points of Contact:**

5.1 **MAJCOM Coordinator**

Major James R. Williams III
AFCEE/ESRU
8001 Inner Circle DR STE 2
Brooks AFB TX 78235-5328
(210) 536-5243
DSN 240-5243
(210) 536-9026 FAX
DSN 240-9026

5.2 **Restoration Team Chief**

Mr. Michael F. McGhee
AFCEE/ESRU
8001 Inner Circle DR STE 2
Brooks AFB TX 78235-5328
(210) 536-5293
DSN 240-5293
(210) 536-9026 FAX
DSN 240-9026

5.3 **Base Point of Contact (POC)**

Mr. Jim Wolfe
11 CEOS/CEVR
21885 Second Street
Elmendorf AFB AK 99506-4420
(907) 552-4532
DSN 317-552-4532
(907) 552-1533 FAX
DSN 317-552-1533

5.4 **Public Affairs Coordinator**

Ms. Wende Wolf
11 CEOS/DEVR
21885 Second Street
Elmendorf AFB AK 99506-4420
(907) 552-4532
DSN 317-552-4532
(907) 552-1533 FAX
DSN 317-552-1533

VI. Deliverables

6.1 Attachment 1 of the Basic Contract

Sequence numbers 1 and 5 listed in attachment 1 to the basic contract apply to all orders. Guidance for preparing R&D Status Reports (sequence 1) is contained in the Handbook, section 4. In addition, the sequence numbers and dates listed below are applicable to this order:

Sequence No.	Para No.	Block 10 (freq.)	Block 11 (as of date)	Block 12 (date of 1st. submit.)	Block 13 (date of final report)	Block 14 (no. of copies)
3 (NETWORK ANALYSIS)	I.1.4.1a	QTRLY	12APR93	30APR93	a	4
4 (WORK PLAN)	I.1.4.1b	ONE/R	12APR93	30MAY93	30JULY93	b
4 (SAP)	I.1.1.4c	ONE/R	12APR93	30MAY93	30JULY93	b
4 (HSP)	I.1.4.1d	OTIME	12APR93	30MAY93	-	10
4 (COMM. REL. PLAN)	I.1.1.4e	ONE/R	12APR93	30MAY93	31DEC93	b
16 (SPECIAL NOTIF.)	I.1.4.2	OTIME	c	c	-	3
9 (PRESNT. MATERIAL)	I.1.4.3	ASREQ	d	d	-	10
18 (MTG. RPTS)	I.1.4.4	ONE/R	e	e	-	5
3 (NEWSLETTER)	I.1.4.5	QTRLY	12APR93	30NOV93	a	f
3 (FACT SHEETS)	I.1.4.6	ASREQ	12APR93	15JUL93	g	-
3 (PUBLIC NOTICES)	I.1.4.7	ASREQ	12APR93	15JUL93	g	h
9 (PHOTO NOTEBOOK)	I.1.4.8	OTIME	12APR93	15JUL93	-	1
3 (MAILING LIST)	I.1.4.9	QTRLY	12APR93	15JUL93	a	-
3 (MAPS)	I.1.4.10	OTIME	12APR93	15JUL93	-	2
4 INFO REPOS	I.1.4.11	OTIME	31JUL93	-	31JAN94	2
3 (IRPMS Data ITIR) (Data Management) BCHCON BCHLDI BCHSLI BCHWCI BCHSAMP BCHCALC BCHLTD BCHTEST BCHRES BCHGWD	I.1.4.12	OTIME	31JUL93	31JAN94	31MAR94	2
4 DECISION DOC	I.1.4.13	ONE/R	i	i	31OCT94	b
4 RI REPORT	I.1.4.14.1	ONE/R	15SEP93	15FEB94	30APR94	b
4 RISK ASSESSMENT	I.1.4.14.2	ONE/R	1OCT93	16MAY94	15JUL94	b
4 FEASIB. STUDY	I.1.4.14.3	ONE/R	30SEPT93	30AUG94	-	b
4 RI/FS Report	I.1.4.14.4	ONE/R	30SEP93	30SEP94	1JAN95	b
4 IRP DOCUMENT	I.14.15	ONE/R	31JUL93	31OCT93	10DEC93	b
3 SCREENING ALTER ITIR	I.1.4.16a	OTIME	30SEP93	30DEC93	-	10
3 DETAL ANALYSIS ALTER ITIR	I..1.4.16.b	OTIME	28 FEB94	30MAR94	-	10
1 DPM SCORING	I.1.4.16c	OTIME	30SEP93	j	j	3
3 MYLAR MAP	I.1.4.16d	OTIME	k	k	-	5
3 GEOPHYS CONT	I.1.4.16.e	OTIME	l	l	-	10
3 SOIL GAS MAP	I.1.4.16f	OTIME	l	l	-	10
4 SCS ITIR	I.1.4.16g	ONE/R	15SEP93	30NOV93	15FEB94	5
4 WEEKLY ACT REP	I.1.4.16h	WEEKLY	13AUG93	13AUG93	-	1

6.2 Reserved.

6.3 Notes

a. Submit Quarterly Thereafter.

b. One (1) first draft plan (8 copies), one (1) second draft plan (8 copies), and one (1) final plan (10 copies) are required. Incorporate Air Force comments into the second draft and final plan as specified by the RTC. Supply AFCEE/ESR with an advance copy of the first draft, second draft, and

final plan for acceptance prior to distribution. Distribute the remaining copies of each plan as specified by the RTC. The second and final reports shall be submitted within three (3) weeks of receipt of comments from the RTC.

c. Primary and Secondary Documents. One first draft report (25 copies), one second draft report (25 copies), and one final report (35 bound copies plus the original camera-ready copy and a 3.5 inch disk formatted in WordPerfect 5.1 containing the document file) are required. Incorporate Air Force comments into the second draft and final reports as specified by the RTC. Supply the RTC with an advance copy of the first draft, second draft, and final reports for acceptance prior to distribution. Distribute the remaining copies as specified by the RTC .

d. Provide written notice with supporting documentation within three (3) days of telephone notification and at the direction of the RTC. Assume a maximum of 100 pages.

e. Provide within one (1) week of task/meeting completion.

f. Provide 500 copies of the Newsletters and distribute as agreed to by the RTC. This includes mailing the final product to on-base personnel and addresses on the existing mailing list.

g. Provide draft and final deliverables. Provide two advance copies to the AFCEE RTC and to the 11 CEOS Community Relations Coordinator for acceptance prior to preparation of the final deliverables.

h. Provide poster-size map.

i. Submit with the second draft Technical Report

j. Submit with the Technical Report

k. Provide with the Technical Report

l. Provide within four (4) weeks of task completion

ANNEX-A, TABLE A-1
SUMMARY OF ESTIMATED FIELD WORK
FOR COST-ESTIMATING PURPOSES ONLY

Estimated Number of Monitor Wells to be Constructed	5
Estimated Footage of Monitor Wells	100
Estimated Number of Water Samples for Lab Analysis	339
Estimated Number of Surface and Subsurface Soil Sampling	1350
Estimated Number of Soil Samples from Augerings	1350
Estimated Number of Containerized Waste Samples	40
Estimated Number of Disposal Water Samples	5
Estimated Number of Sludge Samples	5
Estimated Number of Wipe Samples	3
Estimated Number of Geophysical Surveys	3
Estimated Total Number of Survey Days	20
Estimated Number of Soil Gas Survey Days	20

Annex-A, Table A-2
Analytical METHODS AND ESTIMATED TOTAL NUMBER OF SOIL ANALYSES
(for Cost Estimating Purposes Only)

	analytical method (a)	Reporting Units	Number of Analyses	Trip Blanks	Amb. Cond Blanks	Equipment Blanks	Dup/Rep	Second Column (b)	Total Analyses
Petroleum Hydrocarbon (Gasoline Range Organics)	SW3050/SW8015 (mod)	mg/Kg	400	20	20	20	40	-	500
Petroleum Hydrocarbon (Diesel Range Organics)	SW3050/SW8015 (mod)	mg/Kg	400	-		20	40	-	460
ICP Screen (23 Metals, exclude Boron and Silica)	SW3050/SW6010	mg/Kg	100	-	-	6	10	-	116
Arsenic	SW3050/SW7060	mg/Kg	-	-	-	-	-	-	0
Lead	SW3050/SW7421	mg/Kg	-	-	-	-	-	-	0
Mercury	SW7471	mg/Kg	-	-		-	-	-	0
Selenium	SW3050/SW7740	mg/Kg	-	-		-	-	-	0
Organochlorine Pesticides and PCBs	SW3540/SW8080	mg/Kg	500	-	-	20	50	250	820
Volatile Organic Compounds	SW8240	mg/Kg	72	8	8	4	7	36	135
Semivolatile Organic Compounds	SW3540/SW8270	mg/Kg	100	-	-	10	10	-	120
Polynuclear Aromatic Hydrocarbons	SW3540/SW8310	mg/Kg	-	-		-	-	-	0
Volatile Organic Compounds	SW5030/SW8010	mg/kg	-	-		-	-	-	0
Volatile Organic Compounds	SW5030/SW8020	mg/kg	-	-		-	-	-	0
Volatile Organic Compounds	SW5030/SW8260	mg/kg	-	-	-	-	-	-	0
Total Organic Compounds	SW5030/SW9060	mg/kg	88	-	-	-	4	8	100
Cyanide, Total	SW9010	mg/Kg	-	-		-	-	-	0
Toxic Characteristic Leaching Procedures (TCLP)	SW1311	mg/L	40	-	-	-	-	-	40
Soil Moisture Content	ASTM D2216	Percent (%)	650	-	-	-	-	-	650
Soil PH	SW9045		650	-	-	-	-	-	650
Sulfer Cleanup/Florisil Cleanup	SW3660/SW3620		-	-	-	-	-	-	0
Gel-Permeation Cleanup	SW3640		-	-	-	-	-	-	0
Total Analyses			3000	28	28	80	161	294	3591

Annex A, TABLE A-3
Analytical Methods and Estimated Total Number of Water Analyses
(For Cost Estimating Purposes Only)

	analytical method (a)	Reporting Units	Number of Analyses	Trip Blanks	Amb. Cond Blanks	Equipment Blanks	Dup/Rep	Second Column(b)	Total Analyses
Alkalinity-Carbonate, Bicarbonate, & Hydroxide (field test)	A403	mg/L	10			-	1	-	11
Specific Conductance (field test)	E120.1	mg/L	10			-	1	-	11
pH (field test)	E150.1	µmhos/cm	15	-	-	-	2	-	17
Residue, Filterable (Total Dissoloved Solids)	E160.1	mg/L	80	-	-	3	8	-	91
Non-Filterable Residue (Total Suspended Solids)	E160.2	mg/L	80	-	-	-	8		88
Temperature (field test)	E170.1	deg C	200	-	-	-	-	-	200
Common Anions (Chloride, Fluoride, Sulfate)	E325.1	mg/L	-	-	-	-	-	-	0
Nitrogen, Nitrate+nitrite	E353.2	mg/L	-		-	-	-	-	0
ICP Screen (23 metals, exclude Boron and Silica)	SW3005/SW6010	mg/L	100	-	-	7	25	-	132
Arsenic	SW7060	mg/L	-		-	-	-	-	0
Lead	SW3005/SW7421	mg/L	100	-	-	2	10	-	112
Mercury	SW7470	mg/L	-		-	-	-	-	0
Selenium	SW7740	mg/L	-	-	-	-	-	-	0
Petroleum Hydrocarbons (Gasoline Range Organics)	SW5030/SW8015 (mod.)	mg/L	150	10	10	5	35	-	210
Petroleum Hydrocarbons (Diesel Range Organics)	SW5030/SW8015 (mod.)	mg/L	150	-	-	5	35	-	190
Purgeable Halocarbons	SW5030/SW8010	µg/L	150	8	8	4	25	75	270
Nonhalogenated Volatile Organics	SW5030/SW8015	µg/L	150	8	8	4	25	125	320
Purgeable Aromatics	SW5030/SW8020	µg/L	150	8	8	4	25	125	320
Organochlorine Pesticides and PCBs	SW3510/SW8080	µg/L	166	-	-	3	17	83	269
Semivolatile Organic Compounds	SW3510/SW8270	µg/L	150	-	-	4	15	-	169
Polynuclear Aromatic Hydrocarbons	SW3510/SW8310	µg/L	150	-	-	4	15	-	169
Volatile Organic Compounds	SW3510/SW8260	µg/L	-		-	-	-	-	0
Volatile Organic Compounds	SW3510/SW8240	µg/L	150	8	8	4	25	125	320
Total Organic Compounds	SW9060	µg/L	80			4	10		94
Total Petroleum Hydrocarbon (WTPH-HCID)	E418.1	mg/L	-	-	-	-	-	-	0
Sulfur Cleanup/Florisil Column Cleanup	SW3660/SW3620	-	-	-		-	-	-	0
Gel-Permeation Cleanup	SW3640	-	-	-	-	-	-	-	0
COLUMN TOTALS	-		2041	42	42	53	282	533	2993

Notes:

a Unless an abbreviated list of analytes is specified under "Parameter" above, the analytical protocol shall include all analytes listed in the referenced analytical method. The methods cited are from the following sources:

"A" Methods	Standard Methods for the Examination of Water and Wastewater, 16th Edition (1985)
"E" Methods	Methods for Chemical Analysis of Water and Wastes, EPA Manual, 600/4-79-020 (USEPA, 1983--with additions)
"SW" Methods	Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition (USEPA, 1986)
"ASTM" Methods	American Society for Testing and Materials, 1919 Race treet, Philadelphia, PA 19103

b The maximum number of second-column confirmation analyses shall not exceed fifty (50) percent of the actual number of field samples (to include duplicates, replicates, ambient, condition blanks, trip blanks, and equipment blanks). If the number of samples requiring second-column confirmation exceeds this allowance, contact the HSD Technical Project Manager. The total number of samples listed in Tables A-4 and A-5 includes the allowance applicable to each GC method. IF GC/MS, or a combination of second-column GC and GC/MS, is used, the total cost of all such analyses for a particular parameter shall not exceed the funding allowed for positive confirmation using only second-column GC.

REF 68X 68X

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. PAGE 1 OF

2. PROG INSTRUMENT ID NO. (PIIN): F33615-90-D-4010
3. SPIIN: 002203
4. EFFECTIVE DATE: 94 FEB 15
5. REQUISITION/PURCHASE REQUEST PROJECT NO.: FY7624-94-08235
6. SCO/DMS RATING

7. ISSUED BY — CODE FA8900
DEPARTMENT OF THE AIR FORCE
AIR FORCE MATERIAL COMMAND
HUMAN SYSTEMS CENTER/PK
8005 9TH STREET
BROOKS AFB, TX 78235-5353
Buyer: EDWIN CUSTODIO/PKVBA
Phone: (210) 536-4493

8. ADMINISTERED BY (IF OTHER THAN BLOCK 7) — CODE S2404A
DCMAO, BALTIMORE
ATTN: CHESAPEAKE
200 TOWNSONTOWN BLVD, WEST
TOWNSON MD 21204-5299

9. CONTRACTOR NAME AND ADDRESS — CODE 69148 — FACILITY CODE
ICF TECHNOLOGY
9330 LEE HIGHWAY
FAIRFAX VA 22031-1207
COUNTY; FAIRFAX
PHONE; (703) 934-3000

IF "S" FOR MULTIPLE FACILITIES SEE SECT "K"

MAILING ADDRESS;
ICF TECHNOLOGY, INC
ATTN; CYNTHIA L. FALCE
FOUR GATEWAY CENTER 12TH FL.
PITTSBURGH PA 15222

ADVANCE COPY

10. SECURITY CLAS: U

11. DISCOUNT FOR PROMPT PAYMENT
1 ST % DAYS
2 ND % DAYS
3 RD % DAYS
NET DAYS
OTHER IF '0' SEE SECT "E"

12. PURCHASE OFFICE POINT OF CONTACT: MVH/M6V/MVH

13. THIS BLOCK APPLIES ONLY TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in block 17. The hour and date specified for receipt of Offers ☐ is extended ☐ is not extended

FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE ISSUING OFFICE PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER.

14. THIS BLOCK APPLIES ONLY TO MODIFICATION OF CONTRACTS

☐ THIS CHANGE IS ISSUED PURSUANT TO ______ THE CHANGES SET FORTH HEREIN ARE MADE TO THE ABOVED NUMBERED CONTRACT/ORDER.

☐ THE ABOVE NUMBERED CONTRACT IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (SUCH AS CHANGES IN PAYING OFFICE, APPROPRIATION DATA, ETC.) SET FORTH HEREIN.

☐ THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF ______ IT MODIFIES THE ABOVE NUMBERED CONTRACT AS SET FORTH HEREIN.

☒ THIS MODIFICATION IS ISSUED PURSUANT TO FAR52.253-3, CHANGES-TIME&MATLS OR LABOR HRS (AUG87)

15. CONTRACT ADMINISTRATION DATA

A. KIND OF MOD	B. MOD ABST RECIPIENT ADP PT	C. DATE OF SIGNATURE MODIFICATION	D. CHANGE IN CONTRACT AMOUNT INCREASE (+) DECREASE (-)	E. LOSING PO/CAO ON TRANSFER	F. GAINING PO/CAO ON TRANSFER	G. SVC/AGENCY USE
C			$			

16. ENTER ANY APPLICABLE CHANGES

A. PAY CODE	B. EFFECTIVE DATE OF AWARD	C. CONTRACT (1) TYPE (2) KIND	D. TYPE CONTR	E. SURV CRIT	F. SPL CONTR PROVISIONS	G. PAYING OFC CODE	H. DATE SIGNED	I. SECURITY (1) CLAS (2) DATE OF DD 254

17. REMARKS (Except as provided herein, all items and conditions of the contract, as heretofore changed, remain unchanged and in full force and effect.)
SUBJECT: TIME EXTENSION AT NO INCREASE IN CEILING AMOUNT
PROJECT OFFICER: MICHAEL F. MCGHEE, AFCEE/ESR, BROOKS AFB, TX 78235-5328
FINANCE OFFICE: (SC1030) DFAS-COLUMBUS CENTER
ATTN:DFAS-CO/CHESAPEAKE DIV.
P.O.BOX 182264, COLUMBUS OHIO 43218-2264

18. ☒ CONTRACTOR/OFFEROR IS NOT REQUIRED TO SIGN THIS DOCUMENT ☐ CONTRACTOR/OFFEROR IS REQUIRED TO SIGN THIS DOCUMENT AND RETURN COPIES TO ISSUING OFFICE

19. CONTRACTOR/OFFEROR (Signature of person authorized to sign)
BY

20. NAME AND TITLE OF SIGNER (Type or print)

21. DATE SIGNED

22. UNITED STATES OF AMERICA (Signature of Contracting Officer)
BY Gary J Macdecy

23. NAME OF CONTRACTING OFFICER (Type or print)
GARY J. MACDECY

24. DATE SIGNED: 94 FEB 17

1. Pursuant to the "Changes" Clause of Section I of the basic contract. The performance period and the final delivery schedule are changed from 15 Feb 94 (performance period) and 1 Jan 95 (final delivery schedule date) to 31 Dec 94. The ceiling amount of this delivery order will not be affected by this modification. This modification was generated by request of the contractor with no increase to the ceiling amount. contractor's letter dated 10 Feb 94 is incorporated to this document by reference.

ADVANCE COPY

REF 68X

CONTRACTOR COPY

68X

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. PAGE 1 OF 4

2. PROC INSTRUMENT ID NO. (PIIN)	3. SPIIN	4. EFFECTIVE DATE	5. REQUISITION/PURCHASE REQUEST PROJECT NO.	6. BCC/DMS RATING
F33615-90-D-4010	002204	.IL DATE	FY7624-94-08663	

7. ISSUED BY CODE FA8900

DEPARTMENT OF THE AIR FORCE
AIR FORCE MATERIEL COMMAND
HUMAN SYSTEMS CENTER/PKVBC
8005 9TH STREET
BROOKS AFB TX 78235-5318
Buyer: BRENDA DILLARD, HSC/PKVBB
Phone: (210) 536-4503

8. ADMINISTERED BY (IF OTHER THAN BLOCK 7) CODE S2404A

DCMAO BALTIMORE
ATTN: CHESAPEAKE
200 TOWSONTOWN BLVD, WEST
TOWSON MD 21204-5299

9. CONTRACTOR NAME AND ADDRESS CODE 69148 FACILITY CODE

ICF TECHNOLOGY
9330 LEE HIGHWAY
FAIRFAX VA 22031-1207

COUNTY: FAIRFAX
PHONE: (703) 934-3000

IF "Y" FOR MULTIPLE FACILITIES SEE SECT "K"

MAIL DATE

AUG 15 1994

10. SECURITY CLAS U

11. DISCOUNT FOR PROMPT PAYMENT

NONE

1 ST	%	DAYS	NET DAYS
2 ND	%	DAYS	OTHER IF "Y"
3 RD	%	DAYS	SEE SECT "E"

12. PURCHASE OFFICE POINT OF CONTACT

MEC/M5E/MVT

13. THIS BLOCK APPLIES ONLY TO AMENDMENTS OF SOLITCITATIONS

☐ The above numbered solicitation is amended as set forth in block 17. The hour and date specified for receipt of Offers ☐ is extended ☐ is not extended

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation, or as amended by on of the following methods:

(a) By signing and returning ________ copies of this amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE ISSUING OFFICE PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter provided such telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

14. THIS BLOCK APPLIES ONLY TO MODIFICATION OF CONTRACTS

☐ THIS CHANGE IS ISSUED PURSUANT TO ________ THE CHANGES SET FORTH HEREIN ARE MADE TO THE ABOVED NUMBERED CONTRACT/ORDER.

☐ THE ABOVE NUMBERED CONTRACT IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (SUCH AS CHANGES IN PAYING OFFICE, APPROPRIATION DATA, ETC.) SET FORTH HEREIN.

☐ THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF ________ IT MODIFIES THE ABOVE NUMBERED CONTRACT AS SET FORTH HEREIN.

☒ THIS MODIFICATION IS ISSUED PURSUANT TO FAR 52.243-3, CHANGES - TIME AND MATERIALS OR LABOR HOU:

15. CONTRACT ADMINISTRATION DATA

A. KIND OF MOD	B. MOD ABST RECIPIENT ADP PT	C. DATE OF SIGNATURE MODIFICATION	D. CHANGE IN CONTRACT AMOUNT INCREASE (+) DECREASE (-)	E. LOSING PO/CAO ON TRANSFER	F. GAINING PO/CAO ON TRANSFER	G. SVC/AGENCY USE
C			$			

16. ENTER ANY APPLICABLE CHANGES

A. PAY CODE	B. EFFECTIVE DATE OF AWARD	C. CONTRACT (1) TYPE (2) KIND	D. TYPE CONTR	E. SURV CRIT	F. SPL CONTR PROVISIONS	G. PAYING OFC CODE	H. DATE SIGNED	I. SECURITY (1) CLAS (2) DATE OF DD 254

17. REMARKS *(Except as provided herein, all items and conditions of the contract, as heretofore changed, remain unchanged and in full force and effect.)* SUBJECT: REVISION TO STATEMENT OF WORK
PROJ MNGR: SAMER N. KARMI, AFCEE/ERDW, 8001 INNER CIRCLE, BROOKS AFB, TX
FINANCE OFFICE: (SC1030)DFAS COLUMBUS CENTER, ATTN: DFAS-CO/CHESAPEAKE DIV
PO BOX 182264, COLUMBUS OH 43218-2264

18. ☒ CONTRACTOR/OFFEROR IS NOT REQUIRED TO SIGN THIS DOCUMENT ☐ CONTRACTOR/OFFEROR IS REQUIRED TO SIGN THIS DOCUMENT AND RETURN ________ COPIES TO ISSUING OFFICE

19. CONTRACTOR/OFFEROR *(Signature of person authorized to sign)*		22. UNITED STATES OF AMERICA *(Signature of Contracting Officer)*	
BY		BY William M Watts	
20. NAME AND TITLE OF SIGNER *(Type or print)*	21. DATE SIGNED	23. NAME OF CONTRACTING OFFICER *(Type or print)* WILLIAM M. WATTS	24. DATE SIGNED 15 AUG 94

1. Pursuant to the "Changes" Clause in Section I of the basic contract, the Statement of Work for Delivery Order 0022, dated 06 Jul 93 is superseded by the revised Statement of Work, dated 17 Jul 94. The subject delivery order ceiling amount is increased by $229,526.00.

2. As a result of paragraph 1 above, the said order is more specifically modified as set forth below:

a. SECTION A - Cover Page - The Not-to-Exceed amount in block 20 (cover page) is increased BY $229,526.00 from $3,299,352.00 to $3,528,878.00."

b. SECTION B - THE SCHEDULE

Item No	Supplies/Services		Quantity Purch Unit	Unit Price Total Item Amount
0001	CLIN Change	sec class: U	1 LO	N N

noun: SAMPLING, ANALYSIS AND DATA
acrn: XA nsn: N
site codes: pqa: D acp: D fob: D
pr/mipr data: FY7624-94-08202, FY7624-93-08305, FY7624-94-08353, FY7624-94-08235, and FY7624-94-08663
type contract: Y

descriptive data:
Conduct work in accordance with the Statement of Work (SOW) of this order, dated 17 JUL 94 and Section C, The Description/Specifications of the Basic contract. Submit data in accordance with Attachment #1, the Contract Data Requirements List (CDRL) of the basic contract as implemented by paragraph VI of this order's SOW. This modification adds $83,590.00 to the price for CLIN 0001.

Item No	Supplies/Services		Quantity Purch Unit	Unit Price Total Item Amount
0002	CLIN Change	sec class: U	1 LO	N N

noun: SAMPLING, ANALYSIS AND DATA
acrn: XA nsn: N
site codes: pqa: D acp: D fob: D
pr/mipr data: FY7624-94-08202, FY7624-93-08305, FY7624-94-08353, FY7624-94-08235, and FY7624-94-08663
type contract: Y

descriptive data:
Provide support in accordance with the Statement Work (SOW) of this order, dated 17 JUL 94 and Section C, The Description/Specification of the basic contract. This modification adds $128,148.00 to the price for CLIN 0002.

SECTION B - THE SCHEDULE (Cont'd)

Item No	Supplies/Services		Quantity Purch Unit	Unit Price Total Item Amount
0004	CLIN Change	sec class: U	1 LO	N N

noun: CHEMICAL ANALYSES
acrn: XA nsn: N
site codes: pqa: D acp: D fob: D
pr/mipr data: FY7624-94-08353, FY7624-94-08235, and FY7624-94-08663
type contract: Y

descriptive data:
This modification adds $17,788.00 to the price for CLIN 0004.

c. SECTION C - Description/Specs - The SOW for this order entitled "Installation Restoration Program Remedial Investigation/Feasibility Study, Distant Early Warning (DEW) Line Sites and Cape Lisburne AFS, AK", dated 17 Jul 94 is attached hereto as Attachment #1 to this modification.

d. SECTION F - Supplies Schedule Data - The delivery schedule is modified as set forth below:

Item No	Supplies Schedule Data		Delivery Quantity	Schedule Date
0001	CLIN Del Sch Change acrn: XA ship to: U	sec class: U	1	95APR01
0002	CLIN Del Sch Change acrn: XA ship to: U	sec class: U	1	95APR01
0004	CLIN Del Sch Establish acrn: XA ship to: U	sec class: U	1	95APR01

e. SECTION G - Accounting Classification Data:

ACRN	Acct Class data	Appropriation/Lmt Subhead/CPN Recip DODAAD Supplemental Accounting Classification		Obligation Amount
AC	ACCOUNT ESTABLISH UNCLASSIFIED	5743400 304 7431 434419 040000 53440 000000 674400	F74400	$229,526.00+
	pr/mipr data: FY7624-94-08663			
XA	SPECIAL ACRN CHANGE UNCLASSIFIED			

descriptive data:
Special ACRN XA funds CLINs 0001, 0002, and 0004 and includes the following:

AA:$ 299,855.00
AB:$ 99,986.00 (mod 0022,01)
:$2,899,511.00 (mod 0022,02)
AC:$ 229,526.00 (mod 0022-04)
TOTAL $3,528,878.00

FINANCE OFFICER: Pay funds in alphabetical order.

3. All other terms and conditions remain unchanged.

1994 JUL 17 ~~1993 JUL 6~~

STATEMENT OF WORK
INSTALLATION RESTORATION PROGRAM
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

~~STAGE 1~~

DISTANT EARLY WARNING (DEW) LINE SITES and CAPE LISBURNE AFS, AK

I. DESCRIPTION OF WORK

1.1 Scope

1.1.1 **Background.** The objective of the Air Force Installation Restoration Program (IRP) is to assess past hazardous waste disposal and spill sites on Air Force installations and develop remedial actions consistent with the National Contingency Plan (NCP) for those sites which pose a threat to human health and welfare or the environment. This objective is achieved through a Remedial Investigation Feasibility Study (RI/FS) process in which conclusions and recommendations drawn from accurate and validated data are used to structure and guide subsequent activities.

The RI/FS process includes scoping to define data requirements and objectives, a remedial investigation to characterize sites for a baseline risk assessment, and a feasibility study to define and evaluate alternative remedial actions so that a recommended action may be selected. Each of these steps of the RI/FS process can be conducted in stages that focus on particular aspects of the process.

The Contractor shall accomplish the actions described in this Statement of Work (SOW) to complete the RI/FS process at the following seven Dew Line Sites and Cape Lisburne:

Barter Island AFS (BAR-M); Bullen Point AFS (POW-3); Point Lonely AFS (POW-1); Point Barrow AFS (POW-M); Point Lay AFS (LIZ-2); Wainwright AFS (LIZ-3); and Oliktok Point AFS (POW-2).

1.1.2 **Requirements for Project Activities.** Th~~e Installation Restoration Program (IRP) Handbook referenced in this Statement of Work provides requirements for laboratory and field activities and applicable formats for project documents that shall be used by the Contractor. Volume 1 of the Handbook dated May 1992 is provided under separate cover. This document is referenced in this Statement of Work as the Handbook.~~ The Handbook to Support the Installation Restoration Program (IRP) Statements of Work, dated September 1993, referred to in this SOW as "The Handbook," is provided under separate cover as general guidance only. Any reference within the Handbook language regarding compliance and/or formats for reports as a requirement of this Delivery Order shall be considered deleted. If a conflict is identified between this general guidance and any OSWER, U.S. Environmental Protection Agency (EPA), or other regulatory guidance or requirements, the Handbook shall be disregarded. Also, references to requirements for approval for deviations throughout the Handbook shall be considered invalid. Finally, the Method Detection Limits (MDLs) identified in the Handbook are a consolidation of numerous CFR documents which incorporate current EPA requirements. However, the Contractor shall be responsible for any updates in the CFR. The Contractor is responsible for the thorough knowledge and understanding of the previous findings and recommendations that affect this

task prior to the start of field activities. The documents involved include but are not limited to the IRP Phase I Records Search, and the IRP Phase II plans and reports addressing the Dew Line Sites and Cape Lisburne.

1.1.3 **Meetings.** ~~A maximum of two (2) Contractor personnel, including the project leader, shall attend eight (8) meetings at Elmendorf AFB, AK. Each meeting shall be two (2) 8-hour workdays in duration.~~ All meetings shall be coordinated by the Restoration Team Chief (RTC).

1.1.4 **Special Notifications.** The Contractor shall immediately report to the RTC via telephone, any data or results generated during this investigation which may indicate an imminent health risk. Following this telephone notification, a written notice shall be prepared and delivered within three (3) days. This notification shall include supporting documentation (sequence 16, para 6.1)

1.2 Project Scoping Documents

The purpose of the project scoping documents is to clearly and comprehensively define project activities prior to the initiation of field work. The Contractor shall prepare and submit the following project scoping documents for this task prior to the initiation of any field activities, removal actions, or laboratory analyses.

1.2.1 **Engineering Network Analysis.** Provide within ten (10) days after the issuance of an order a computer generated network analysis which is a detailed task plan for the RI/FS work efforts. The network analysis (GANTT) chart shall be in the form of a progress chart of suitable scale to indicate appropriately the percentage of work scheduled for completion by any given date during the period of the delivery order. The network analysis (GANTT) shall show both serial and parallel subtasks leading to a deliverable product or report, and shall show early and late start and completion dates with float. The network analysis (GANTT) shall be updated and submitted quarterly (sequence 3, para 6.1).

1.2.2 **Work Plan.** This section will discuss the overall approach, (including a brief summary of the Conceptual Site Model and Data Quality Objectives), major tasks, scope, timeline, and major decision points. Due to the extreme remoteness of the Dew Line Sites and Cape Lisburne, the Contractor shall include a detailed plan for logistics and strategy to complete the RI/FS field activities. Follow the format specified in section 1 of the Handbook. In preparing the Work Plan, use previous reports and the information gathered during the literature search and presurvey along with experience at similar sites. Reevaluate the recommendations for Dew Line Sites and Cape Lisburne developed during previous IRP stages. The Contractor shall also prepare a draft and final addendum to the existing DEW Lines RI/FS work plan. The addendum shall detail the removal activities occurring at Cape Lisburne LRRS pursuant to paragraph I.1.3.14 of this SOW. (sequence 4, para 6.1).

1.2.3 **Sampling and Analysis Plan (SAP).** The SAP consists of a quality assurance plan (QAPP) and a Field Sampling Plan (FSP). Prepare a SAP describing how project activities will be accomplished in the format specified in section 1 of the Handbook. The Contractor shall also prepare a short addendum to this basic SAP which focuses on those sampling and analysis activities undertaken as part of the removal action specified in paragraph I.1.3.14 of this SOW. Incorporate review comments and obtain RTC concurrence prior to the start of field activities (sequence 4, para 6.1).

1.2.4 **Health and Safety Plan (HSP).** Provide a written Health and Safety Plan within eight (8) weeks after the issuance of an order. The Contractor shall also prepare an addendum to the existing DEW Lines RI/FS HSP, concerning removal activities conducted pursuant to paragraph I.1.3.14 of this SOW. The Contractor shall comply with USAF, OSHA, EPA, state, and local health and safety regulations regarding the proposed work effort. Use EPA guidelines for designating the appropriate levels of protection needed at the study sites. The Health and Safety Plan shall provide no less protection than the protection contained in the manual entitled "Health and Safety Requirements for Employees Engaged in Field Activities" dated 1981 and the "Occupational Safety and Health Manual for Hazardous Waste Sites Activities" dated 1985 and 29 CFR 1910. Coordinate the Health and Safety Plan directly with applicable regulatory agencies prior to submittal to AFCEE/ESR. The Contractor shall certify to AFCEE/ESR that the Contractor has reviewed the coordinated Health and Safety Plan with each employee and also subcontractor's employees prior to the time each employee engages in field activities (sequence 4, para 6.1).

1.2.5 **Community Relations Plan.** The Contractor shall prepare a Community Relations Plan (CRP) for the DEW Line Sites and Cape Lisburne AFS outlining the specific public communications and involvement techniques to be used in coordination with remedial site activities (sequence 4, para 6.1). Follow the guidance contained in "Community Relations in Superfund, a Handbook", office of Solid Waste and Emergency Response (OSWER) Directive 9230.0-03C (EPA/540/R-92/009, January 1992, PB92-963341), and other applicable directives. Also, use as a guidance previously accomplished CRP from other installations in Alaska. Appropriately adapt such guidance to the local situation at the DEW Line Sites and Cape Lisburne. As described in OSWER Directive 9230.0-03C, the CRP shall include, but not be limited to, a description of the sites and the community, an overview of the community involvement to date, key community concerns regarding the site and AF site activities, and suggested community relations activities. A contact list of elected officials, agency representatives, and interested groups and individuals shall be included in appropriate copies of the plan. In addition, the plan will include suggested locations for meetings and information repositories. Contractor activities to develop the CRP shall include conducting a review of site information provided by the AF.

1.3 **Project Activities**

The Contractor shall conduct the following tasks to achieve the purposes stated herein, in compliance with approved scoping documents, the Handbook, and all applicable regulations and requirements.

1.3.1 **Community Relations.** Provide support to the base public affairs office for the tasks described below pertaining to the RI/FS Community Relations Program.

1.3.1.1 Public meetings and workshops. The Contractor shall be responsible for coordinating public meetings and workshops for all DEW Line Sites and Cape Lisburne AFS. This includes producing briefing scripts, slides and any associated products such as response cards and sign-in sheets. As requested by the base Community Relations office in coordination with the RTC, research and provide materials for public queries, news media queries, and news releases. Assume a maximum of one (1) workshop/meeting (Seq. nos. 3,9).

1.3.1.2 Public notices. As required by the base Community Relations office and the RTC, the Contractor shall prepare and publish public notices for the Fairbanks and local newspapers. The purpose of these notices is to inform the public of a meeting, workshop, or comment period in which they have the opportunity to be involved in the IRP Program at DEW Line Sites and Cape Lisburne AFS. Also, these notices may be utilized to inform the public of other pertinent program information such as quarterly notices of documents placed in the information repositories. The format for the notices shall be coordinated with the Community Relations office and RTC, and then submitted to the RTC for review prior to delivery to the base. Assume a maximum of two (2) notices (Seq. no. 3).

1.3.1.3 Photo Notebook. The Contractor shall develop a photo notebook which focuses on the overall IRP program at DEW Line Sites and Cape Lisburne AFS. The layout of the notebook will be coordinated with the public affairs office and RTC. Assume a maximum of one (1) update (Seq. no. 9).

1.3.1.4 Mailing List. In coordination with the base Community Relations office and the RTC, prepare and update the mailing list on a quarterly basis. Assume a maximum of two (2) updates (Seq. no. 3).

1.3.1.5 Maps. Prepare presentation quality maps of the installations and their sites to use in newsletters and to distribute to the public.

1.3.1.6 Information Repository/Administrative Record. Prepare a listing of all documents required for the Information Repository and Administrative Record. Create an Information Repository and Administrative Record. The Repository and Record will be maintained by the 11 CEOS/CEVR Community Relations Coordinator. Assume two locations for the Repository and Record, one in Anchorage and another in Elmendorf AFB, AK. Actual locations will be determined by the 11 CEOS/CEVR Community Relations Coordinator.

1.3.2 **Literature Search.** Conduct a literature search and analyze aerial photos of the DEW Line Sties to supplement existing information that has been collected. The purpose of the literature search is to complete the conceptual site model so that a numerical estimate of risk can be developed.

1.3.3 **Presurvey.** Within eight weeks of the issuance of an order, the Contractor shall visit the Dew Line Sites and Cape Lisburne to ensure complete understanding of site conditions. Coordinate this visit with the RTC and the 11 CEOS project manager. The Contractor shall look for evidence of contamination at each site visited (e.g., leaking drums, vegetative stress, leachate seeps). The Contractor shall observe the physical settings of each site visited to formulate specific recommendations concerning boring placement, use of geophysical techniques, and other aspects of the proposed field investigation. The findings of the presurvey shall be used to prepare the Work Plan, SAP, and HSP for the RI and to prepare scoping documents for the treatability study(ies). Assume one presurvey and one reconnaissance trip.

1.3.4 **Quality Assurance/Quality Control (QA/QC).** A QA/QC program shall be conducted and documented for all work pursuant to this delivery order. Contractor and project-specific documents concerning QA/QC procedures and requirements shall be strictly followed. Data generated under the QA/QC program shall be used by the Contractor for evaluating the analytical results and field records assembled for each site to identify accurate and validated data that may be used to assess risk, develop conceptual site models and evaluate alternatives.

1.3.5 **Conceptual Site Model.** Use all available RI/FS data supported by acceptable QA/QC results (as measured against QAPP requirements) and site characterization information to refine, based on newly collected data, the conceptual site model. The model shall define the nature and extent of contamination and the transport and fate of those contaminants. The minimum requirements of the model are given in section 2 of the Handbook. The complexity and detail of the site model shall be consistent with the nature of the site and site problems, and the amount of data available the conceptual site model shall be documented in the Work Plan.

1.3.6 **ARARs Evaluation.** The Contractor shall identify all Applicable or Relevant and Appropriate Requirements (ARAR). These ARARs will be documented in the Work Plan.

1.3.7 **Data Collection, Sampling, and Analysis Procedures.** The Contractor shall conduct field activities, sampling, laboratory analysis, and data quality assessment. Section 2 of the Handbook is recommended for the Contractor to follow. The Contractor shall conduct all activities in accordance with the WP and the SAP approved by the COR. The COR shall be notified in writing of any planned deviation from the activities specified in these documents. COR approval of deviations is required prior to performance. The Contractor shall ensure that all analyses and analytical methods' QA/QC requirements are being met at all times before and during the analysis of samples.

The field investigation (including all drilling and sampling operations) shall be supervised by a registered geologist, hydrogeologist, or professional engineer. If required by the state, the on-site field supervisor shall be certified by the state to install test wells. A detailed log of field conditions, materials penetrated during drilling, well completion, and sampling conditions, as described in Section 2 of the Handbook, shall be maintained and made available for Government inspection upon request. Decisions on well and boring locations, well depths, screened intervals, and all details of the field investigation shall be made by the COR, and the Contractor's field or project supervisor.

1.3.8 **Regulatory Requirements and Permits.** All well drilling, development , sampling, laboratory analysis, and other activities pursuant to this effort shall be conducted in strict accordance with all applicable federal and state laws, ordinances, rules and regulations, and all authorities with jurisdiction over such activities. The Contractor shall complete permits, applications, other documents, and proficiency tests required by the regulatory agencies. The Contractor shall file documents with appropriate agencies and pay all applicable permit and filing fees. The Contractor shall identify locations requiring permits to Radar Station Manager. The Contractor shall include all correspondence in appendices to the technical reports in accordance with Section 4 of the Handbook.

All laboratory analyses shall conform to all applicable federal, state, and local regulatory agency requirements. If the requirements specify that certification is necessary to conduct one or more specific analyses, the Contractor shall furnish documentation showing laboratory certification with the first set of analytical data supplied to AFCEE/ESR and the COR.

The Contractor shall containerize and sample materials suspected to be hazardous in accordance with applicable requirements, Guidance from the Handbook, and the approved Plans. The Contractor shall transport these containerized materials to a location within the installation boundary designated by the Radar Station Manager at a frequency specified by the

Station Manager. The Contractor shall handle, store, and/or dispose of potentially hazardous materials. The Contractor shall transport and empty containerized materials determined not to be hazardous to locations within the installation boundary identified by the Station Manager.

1.3.9 **Remedial Investigation (RI).** The Contractor shall conduct a RI to characterize environmental conditions; define the concentration, nature, and extent of contamination; and quantitatively estimate the risk to human health and the environment and study the area through the collection of geologic and hydrologic data, environmental samples, the laboratory analyses of those samples for potential contaminants, the evaluation of the analytical results and field measurements with respect to quality control data, and the interpretation and analysis of accurate and precise data. The purpose of data collection, sample collection, and laboratory analysis is to determine whether any contaminants generated from installation activities have entered the environment. The field investigation is used to determine the source of any identified contaminants, the magnitude of contamination relative to Applicable or Relevant and Appropriate Requirements (ARARs), and any naturally occurring or background concentrations for specific compounds. The RI shall comply with the specifications, procedures, and methodologies presented in the project-specific SAP. The COR must be notified in writing prior to any modification of or deviation from any activity described in these documents.

1.3.9.1 **Soil Borehole Drilling and Sampling and Well Installation and Sampling.** The Contractor shall drill and collect samples from boreholes as specified in the SAP. The Contractor shall evaluate the need to install, sample, and develop monitoring or extraction wells.

1.3.9.1.1 **Lithologic Samples.** The Contractor shall describe core samples at least every five (5) feet of drilling or at each change in lithology, whichever is less, to indicate significant changes in lithology of characteristic properties that relate to the strata penetrated. Any deviations shall be coordinated with the COR. Guidance for standard identification practices are found in the Handbook. The Contractor shall include in the field logbook observations made by the driller and rig geologist during drilling such as depth to water, penetration rate, drill rig behavior, and other observations that might be indicative of changes in formation characteristics. The Contractor shall record depth to permafrost in all the soil borings and shall not proceed beyond five (5) feet into the permafrost layer.

1.3.9.1.2 **Drill Cuttings and Drilling Fluids.** The Contractor shall containerize all drill cuttings and drilling fluids. All drill cuttings and drilling fluids shall be managed and disposed of in accordance with the project SAP. (Note: The Contractor shall be responsible for providing all necessary containers.) The Contractor shall be responsible for the logistics of the ultimate disposal of all drill fluids or drill cuttings deemed hazardous in accordance with current EPA off-site disposal policy and state and/or local hazardous waste disposal laws. The contractor shall coordinate with the Station Manager for on-site placement and disposal of all drill cuttings, fluids, purge fluid, and excavated material. If on-site disposal is excluded, all hazardous waste shall be transported by a permitted hazardous waste transporter to a licensed Resource Conservation and Recovery Act (RCRA) approved facility and be accompanied by a Uniform Hazardous Waste Manifest. The Contractor shall provide a final, completed copy of the hazardous waste manifest to the 11 CEOS/CEVR. The Radar Stations' hazardous waste managers will sign all hazardous waste manifest documents.

1.3.9.1.3 **Well/Boring Precautions.** The Contractor shall mark the field locations of all borings during the planning/mobilization phase of the field investigation. The Contractor shall consult with base personnel to minimize the disruption of base activities, to properly position wells with respect to site locations, and to avoid penetrating underground utilities. The Contractor shall obtain all permits prior to commencement of digging and drilling operations. The Contractor shall utilize a registered land surveyor in determining the elevations and locations of all off-base background study borings. All borings and wells from which samples are taken shall be surveyed by the Contractor for vertical and horizontal control. The Contractor shall record the positions on project and site specific maps. Bench marks used must have been previously established from and be traceable to a U. S. Coast and Geodetic Survey (USCGS) or U. S. Geological Survey (USGS) survey marker. Clearly identify all bench mark locations on the base map.

1.3.9.1.4 **Water-Level Measurements in Boreholes.** The Contractor shall measure water levels in all boreholes after the water level has stabilized. Include this information and the date of measurement in the boring logs. Also, record soil moisture conditions (moist, wet, saturated, etc.) in the boring log.

1.3.9.1.5 **Air Monitoring During Drilling.** The Contractor shall monitor the ambient air in the breathing zone above the borehole during all drilling with an appropriate organic vapor analyzer to identify potentially hazardous and/or toxic vapors. Include air monitoring results in borehole logs.

1.3.9.1.6 **Subsurface Soil Sampling.** The Contractor shall collect soil samples from borings as specified in the SAP. The SAP specifies the analytical methods, the parameters for analysis, and the estimated number of analyses for soil samples.

1.3.9.1.7 **Well Construction Requirements.** The Contractor shall coordinate with the COR to determine well completion requirements (flush or projected above ground surface). All wells shall be secured as soon as possible after drilling. The Contractor shall provide corrosion resistant locks for both flush and above-ground well assemblies. The locks shall be compatible with existing wells. The Contractor shall turn the lock keys over to 11 CEOS/CEVR POC following completion of the field effort. The Contractor shall coordinate with the 11 CEOS/CEVR POC, the RTC, and the COR the selection of exact well and screen placement, gravel pack design, and screen slot size.

1.3.9.1.8 **Well Logs.** For each well, the Contractor shall prepare a well completion log and schematic diagram showing well construction details. Lithologic descriptions, well elevation survey data, and other information included in the well logs shall conform to the specifications of the SAP.

1.3.9.1.9 **Well Development.** The contractor shall develop each well as soon as possible. Guidance for well development procedures are found in the Handbook. The Contractor shall measure the rate of water production, pH, specific conductance, and water temperature during well development.

1.3.9.1.10 **Well Placement.** The Contractor shall avoid installing wells in depressions or areas subject to frequent flooding and/or standing water. If wells must be installed in such areas, the Contractor shall design the wells so standing water does not leak into the top of the casing or cascade down the annular space.

1.3.9.1.11 **Well and Borehole Clean-up.** The Contractor shall clean the area following the completion of each well and borehole. The Contractor shall return all sites to the original condition of the site.

1.3.9.1.12 **Groundwater and Surface Water Sampling.** The Contractor shall collect groundwater and Surface Water samples from newly developed well and existing wells and from surface water bodies. The SAP shall specify the analytical methods, the parameters for analysis, and the estimated number of analyses for groundwater and surface water samples.

1.3.9.1.13 **Composite Sampling.** The Contractor shall collect and analyze drill cuttings, fluids, purge fluids, and excavated material. The SAP shall specify the analytical methods, the parameters for analysis, and the estimated number of analyses for composite samples.

1.3.9.2 **Geophysical Surveys.** The Contractor shall evaluate whether geophysical surveys are needed (e.g., to determine boundaries of landfills, to locate underground debris, utilities and storage tanks). Where geophysical surveys are appropriate, the Contractor shall select a geophysical survey technique or techniques [such as ground penetrating radar (GPR), magnetometer or electromagnetic surveys (EM)] that will best meet the desired application. The technique(s) used shall be approved by the RTC prior to use. Approximate number of surveying days is included in Annex A which is to be used for costing purposes only. Appropriate grid systems shall be established and the Contractor shall use the results of this survey to prepare a contour map of the results. Provide this map as an attachment to the first R&D Status Report submitted after the completion of the geophysical surveys. The Contractor shall perform the geophysical surveys before drilling and use the results in selecting the location of soil borings, wells, test pits, if necessary.

1.3.9.3 **Permeability Testing.** The Contractor shall determine the need for a permeability test at Cape Lisburne AFS, to provide additional data on the hydrogeologic characteristics of the water table aquifer. The SAP shall specify the method to be used for the permeability test.

1.3.9.4 **Water Level Measurement.** The Contractor shall evaluate the need for conducting a complete round of water level measurements in all existing and new wells at Cape Lisburne AFS at the beginning of field work and during the field sampling effort. Data gathered shall be used for interpreting groundwater flow directions and groundwater gradient.

1.3.9.5 **Soil Gas Surveys.** The Contractor shall evaluate the need for soil gas surveys and Hydropunch (e.g., to select soil boring locations). If soil gas surveys and hydropunch are included as part of the approved Work Plan and FSP, the Contractor shall establish appropriate grid systems. The Contractor shall prepare a posting map of soil gas values relative to their location on the grid used. Provide this map as an attachment to the first R&D Status Report submitted after completion of the soil gas survey (sequence 3, para 6.1). Approximate number of surveying days are included in Annex A which is to be used for costing purposes only.

1.3.9.6 **Groundwater Field Screening.** The Contractor shall perform groundwater field screening. The SAP shall specify the method, location, and type of groundwater field screening.

1.3.9.7 **Baseline Risk Assessment.** The Contractor shall use data supported by acceptable QA/QC results (as measured against QAPP requirements) and the conceptual site model to numerically estimate the risk posed by site contaminants to human health and the environment. The Contractor shall identify and list all ARARs for those contaminants detected in environmental

samples at the site. The Contractor shall provide all ARARs evaluations as an attachment to the Technical Report. Provide the results of the baseline risk assessment in the Technical Report using the formats in Section 4 of the Handbook as a guidance.

The Contractor shall identify those sites posing minimal or no threat to human health, welfare, or the environment and for which no further action is appropriate.

The Contractor shall use the results of the risk assessment in establishing remedial action objectives and developing remedial alternatives in the Feasibility Study.

1.3.9.8 **Defense Priority Model Scores.** The Contractor shall use the Defense Priority Model to score the sites. The score shall be included as an appendix to the RI/FS Technical Report.

1.3.9.9 **Fate and Transport.** The Contractor shall perform fate and transport modeling for contaminants of interest to include the projection of future contaminant concentrations within the boundaries of the site. This will be done in conjunction with the RI/FS report.

1.3.10 **Feasibility Study (FS).** The Contractor shall perform a FS concurrently with the RI. As much of the FS as possible shall be performed early in the RI/FS process and refined as additional RI data are obtained. The Contractor shall use the information from the RI and the baseline risk assessment to develop and evaluate remedial action alternatives for each site where a threat to human health or the environment exists. The Contractor shall follow the procedures specified in USEPA OSWER Directive 9355.3-01, "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA." The Contractor shall employ streamlining methods wherever possible and develop and evaluate the minimum number of alternatives needed to provide a range of promising treatment and containment actions. The Contractor shall eliminate impracticable alternatives from further consideration early in the FS process. The scope and level of detail shall be consistent with the nature and complexity of site problems.

1.3.10.1 **Develop and Screen Alternatives.** The Contractor shall establish remedial action objectives and remediation goals for protecting human health and the environment. These objectives and goals shall be determined based on identified ARARs and acceptable exposure levels as defined in the baseline risk assessment and refined throughout the RI/FS process. Identify general response actions and applicable technologies based on site and contaminant conditions, and combine technologies to formulate distinct alternatives. The Contractor shall develop alternatives which eliminate, control, and /or reduce risk to human health or the environment to acceptable levels for each pathway. Where a wide variety of promising alternatives exists, the Contractor shall screen the alternatives based on effectiveness, implementability, and cost. The Contractor shall detail the development and screening of the alternatives process and identify the alternatives selected for detailed analysis in the Informal Technical Information Report (ITIR).

1.3.10.2 **Detailed Screening of Alternatives.** The Contractor shall conduct a detailed analysis on each alternative selected and identified in the above step and approved by the COR. Using the methodology in OSWER Directive 9355.3-01, the Contractor shall evaluate each alternative against the nine criteria. In addition to the individual assessment, the Contractor shall perform a comparative analysis to determine the relative performance of alternatives. The Contractor shall focus the analysis on sub-factors and criteria most pertinent to each site and the scope and complexity of the

proposed action. Provide a summary of the Detailed Analysis of Alternatives in the R&D report submitted following task completion. Include summary tables of the individual and comparative analyses that will be used in the Technical Report.

1.3.11 **Decision Documents.** The Contractor shall prepare and submit Decision Documents (DD) following the Handbook Section 4.4 as guidance. The purpose of the DD is to support a remedial action alternative or a no further action alternative. The Contractor shall submit an Interim Decision Document detailing the removal action process, results and conclusions.

1.3.12 **Site Specific Requirements.** The Contractor shall perform the requirements listed in this SOW in conformance with the guidance of the Handbook, requirements of the approved WP, and the SAP. Annex A specifies the proposed values for field and laboratory activities to be conducted, specifications for field activities, information for sediment and soil samples, analytical methods, parameters for analysis, estimated number of analyses for water/sediment/soil samples, required analytical methods, estimated number of analyses for all core samples, estimated number soil gas analyses for each parameter, and field QC sample requirements for soil and water samples for costing purposes only.

1.3.13 **Weekly Field Activity Report**

The contractor shall transmit a Weekly field activity report. The reports shall include, but not be limited to, all field work detailed in this SOW, a listing of any problems encountered (e.g., equipment problems, equipment downtime), and actions taken to resolve those problems. ~~The AFCEE RTC shall develop the format for the report.~~

1.3.14 **Removal Actions**

The Contractor shall complete the following tasks to remove or otherwise control source contamination and further characterize site conditions at Cape Lisburne LRRS. The Contractor shall include any data generated during these activities in the pertinent reports.

1.3.14.1 **Task 1** involves placement of an interceptor trench (French drain) below Petroleum, Oil, and Lubricant (POL) Tanks 1 and 2 to capture spilled or leaked petroleum products which are currently migrating through the subsurface toward a nearby surface water body. Collected material shall drain to a sump for separation into its water and petroleum components. Accumulated water shall be treated using granulated activated carbon or appropriate vapor control technology, chemically analyzed for the presence of remaining contaminants, and subsequently, in coordination with Alaska Department of Environmental Conservation (ADEC), disposed of according to all applicable water regulations. Recovered petroleum product will be incinerated on-site, after coordination ADEC. Soils excavated to accommodate the trench may be returned to the surrounding land, provided that they are not considered hazardous under the RCRA "contained-in" policy. Soils which are deemed hazardous may be drummed and sent for off-site disposal according to applicable hazardous waste regulations, or may be stored on-site pending subsequent remedial activities.

1.3.14.2 **Task 2** requires the removal and off-site disposal of a sludge pile located at Landfill and Waste Accumulation Area Number 1. Using a backhoe provided by the base, the sludge pile shall be excavated,

containerized in 55-gallon drums, and transported to a disposal facility in the continental U.S. A temporary drum staging area shall be established nearby to store the drums until they are transported. Current plans may involve shipment of waste on the barge's return trip to Cape Lisburne. Prior to field operations on this task, a representative sample of the sludge must be collected and analyzed using TCLP and other characteristic methods to determine if the material is a hazardous waste. The sludge must be managed and disposed of according to the results of such analyses. After removal of the sludge, the excavated area must also be sampled and analyzed to detect any constituents remaining at the site.

1.3.14.3 **Task 3** involves limited PCB sampling and analysis. The purpose of this task is twofold: to further characterize contamination in ocean sediments adjacent to Landfill and Waste Accumulation Area Number 1, and to locate a reported "hot spot" undiscovered during the 1993 RI/FS sampling program.

1.4 Project Deliverables

Deliver the following documents in compliance with the requirements of item VI, the formats required in section 1 and 4 of the Handbook, and the specifications noted below. Draft reports are considered "drafts" only because they have not been reviewed and approved by the Air Force. In all other respects, "drafts" shall be complete, in the proper format, fully illustrated, and free of grammatical and typographical errors.

1.4.1 Scoping Documents.

a. Engineering Network Analysis (GANTT) (para 1.2.1). Provide within ten (10) days after the issuance of an order. Update and submit quarterly (sequence 3, para 6.1).

b. Work Plan (para 1.2.2). Use the format in section 1 of the Handbook (sequence 4, para 6.1).

c. Sampling and Analysis Plan (1.2.3). Use the format in section 1 of the Handbook (sequence 4, para 6.1).

d. Health and Safety Plan (para 1.2.4). Provide within six (6) weeks after the issuance of an order (sequence 4, para 6.1).

e. Community Relations Plan (para 1.2.5). Provide within eight (8) weeks after issuance of an order (sequence 4, para 6.1).

1.4.2 **Special Notification.** Provide written notification of imminent health hazards and supporting documentation within three (3) days of telephone notification (sequence 16, para 6.1).

1.4.3 **Presentation Materials.** The Contractor shall prepare and present up to two (2) presentation packages at meetings coordinated by the Air Force (sequence 9, para 6.1). Attendance of these meetings is included in paragraph 1.1.3 of this SOW. As part of the presentation materials, the Contractor shall provide paper copies of all slides and overheads.

1.4.4 **Meeting Summaries** (para 1.1.3). Provide no later than five (5) days after conclusion of each meeting (sequence 18, para 6.1).

1.4.5 **Newsletter.** Prepare and submit a quarterly newsletter which presents the status of the entire base IRP Program. This will include preparing an outline resulting from input by all Contractors involved in the program. The outline must be approved by the base and RTC prior to submittal of the newsletter. The final product will be printed and distributed as agreed to by the RTC. Assume a maximum of two (2) newsletters (Sequence no. 3).

1.4.6 **Fact Sheets.** As required by the base IRP Program, prepare and submit fact sheets which facilitate the public's understanding of the IRP Program. These sheets should include key community concerns regarding sites as specified by the base. Use the format agreed to by the base and RTC. Print and distribute the fact sheets as agreed to by the RTC. Assume a maximum of two (2) fact sheets (Sequence no. 3).

1.4.7 **Public Notices.** In accordance with paragraph 1.3.6.2, prepare and submit public notices for the Fairbanks and local newspapers. Use the format agreed to by the base and RTC (Sequence no. 3).

1.4.8 **Photo Notebook.** In accordance with paragraph 1.3.6.3, develop a photo notebook which focuses on the overall base IRP Program. <u>The Contractor shall include photos of sites under investigation, field and removal activities, and sample locations. Photos shall reflect proper sampling techniques, QA/QC procedures, and Health and Safety reports during field activities.</u> Prior to implementation, submit a conceptual layout of the notebook for review by the base and RTC (Sequence no. 9).

1.4.9 **Mailing List.** In accordance with the base Community Relations coordinator and paragraph 1.3.6.4, update the existing mailing list on a quarterly basis (Sequence no. 3).

1.4.10 **Maps.** In accordance with the base community Relations coordinator and paragraph 1.3.6.5, prepare presentation quality maps.

1.4.11 **Information Repository/Administrative Records.** Submit the Information Repository and Administrative Records in accordance with Air Force Guidance and in concurrence with the COR and the base Community Relations Coordinator. (sequence no. 4, para 6.1)

1.4.12 **Data Management.** The Contractor shall meet the data deliverable requirements of the Installation Restoration Program Information Management System (IRPIMS). The Contractor shall be responsible for recording field and laboratory data into a computerized format as required by the most current version of the IRPIMS Data Loading Handbook (mailed under separate cover). In order to perform this task, the Contractor shall use the IRPIMS Quality Control Tool (QC Tool) and PC software utility (mailed under separate cover with software manual) to quality check ASCII data files and to check all data files for compliance with requirements in the IRPIMS Data Loading Handbook. Upon request, the IRPIMS Contractor Data Loading Tool (CDLT) is available. This PC software is designed to assist the Contractor in preparing the various ASCII data files.

Individual IRPIMS data files (e.g., analytical results, groundwater level data, etc.), including resubmissions, shall be delivered with a transmittal letter by the Contractor to the Air Force Center for Environmental Excellence (AFCEE) in sequence according to a controlled time schedule as identified in the current version of the IRPIMS Data Loading Handbook. The Contractor shall include a copy of the Quality Control Tool error report, i.e., output from the QC tool, for each IRPIMS file submission. The error report shall be

submitted both in hard copy and as an electronic file on the submission disks with the filename of the error report identified in the transmittal letter (SEQUENCE No. 3).

All Contractor data deliverables shall be sent to:

AFCEE/ESD BLDG 624W
ENVIRONMENTAL RESTORATION DIVISION
ATTN: IRPIMS Data Management
Brooks AFB, TX 78235-5000

In addition, the Contractor shall provide a copy of the transmittal letter to the Air Force contracting office responsible for the contract, HSC/PKV (Brooks AFB, TX, 78235-5000) for AFCEE contracts. This letter shall identify the files included or otherwise omitted (with an appropriate explanation), the Government contract and delivery order number, and the Air Force POC that is responsible for monitoring the Government contract.

The Contractor shall be responsible for the accuracy and completeness of all data submitted. All data entered into the IRPIMS data files and submitted by the Contractor shall correspond exactly with the data contained in the original laboratory reports and other documents associated with sampling and laboratory contractual tasks.

Each file delivered by the Contractor will be electronically evaluated by AFCEE/ESD for format compliance and data integrity in order to verify acceptance. All files delivered by the Contractor are required to be error-free and in compliance with the IRPIMS Data Loading Handbook. Any errors identified by AFCEE/ESD in the submission shall be corrected by the Contractor.

1.4.13 **Decision Document.** The Contractor shall prepare and submit DD as described in Section 1.3.11 (SEQUENCE No. 4, para 6.1).

1.4.14 **Technical Reports.** Summarize the findings of the tasks pursuant to the SOW, integrate them with the results of all pertinent previous studies, and formulate conclusions and recommendations for future efforts in Technical Reports.

1.4.14.1. **Remedial Investigation (RI) Report** (para 1.3.3). Provide a RI Report following the format in section 4 of the Handbook (sequence 4, para 6.1).

1.4.14.2. **Risk Assessment (RA) Report** (para 1.3.3.7). Provide a RA Report following the format in section 4 of the Handbook (sequence 4, para 6.1).

1.4.14.3 **Feasibility Study Report** (para 1.3.4). Provide a Feasibility Study Report following the format in section 4.0 of the Handbook. (sequence 4, para 6.1).

1.4.14.4 **RI/FS Technical Report** (para 1.3.3). Provide a RI/FS Technical Report following the format in section 4.0 of the Handbook. The RI/FS Technical Report shall integrate the RI, RA, and FS reports. Provide two microfiche copies with the final RI/FS Technical Report (sequence 4, para 6.1).

1.4.15 **Basewide Comprehensive IRP Document.** The Contractor shall develop a comprehensive document that summarizes both the historic and projected IRP activities. This document shall be used as management tool to efficiently guide future IRP activities at the DEW Line Sites and Cape Lisburne AFS. The Contractor shall follow the outline developed by the AFCEE RTC. Assume two (2) updates (sequence no. 4)

1.4.16 **Analytical Data ITIR.** Prepare and submit the following ITIRs, as well as the Analytical Data ITIR itself:

a. Development & Screening of Alternatives (para. 1.3.10.1). Submit the results of the development and screening of alternatives in an ITIR prepared in compliance with section 3 of the Handbook (sequence 3, para 6.1)

b. Detailed Screening of Alternatives (para 1.3.10.2).

c. DPM Scoring (para 1.3.9.8). Provide scores, a summary of procedures and assumptions, and Automated DPM output tables for all sites scored with DPM (sequence 3, para 6.1).

d. Mylar^R Map. Construct Radar Stations' maps of Mylar using guidelines in section 3 of the Handbook. The Maps shall contain all sites and related water and sediment sampling locations (sequence no. 3, para. 6.1). The Contractor shall create and update digitized map files. Use the digitized data file to produce the Mylar map. The Contractor shall print the revision date on the Mylar maps and the date shall be encoded in the digitized data file. Provide a copy of the revised digitized data file to AFCEE-ESO/ER (sequence 1, para. 6.2).

e. Geophysical Survey Contour Map (para 1.3.9.2). Provide a contour map showing geophysical survey results. Interpret the significance of the data in the R&D Status Report (sequence 3, para 6.1).

f. Soil Gas Map (para 1.3.9.5). Provide site maps showing soil gas data superimposed on the sampling locations and incorporate soil gas data generated by the 11 CEOS/CEOR. Interpret the significance of the data in the R&D Status Report (sequence 3, para 6.1).

g. Site Characterization Summary Informal Technical Information Report (SCS ITIR). The Contractor shall prepare the report to include the following components:

1. Source identification and contaminant delineation.

2. Identification and ranking of appropriate treatability studies for the listed sites.

3. Data and interpretations integrating the findings of the current study and all previous RI efforts at the sites.

4. Current isoconcentration plots of contaminants detected at each site, lithologic logs of each boring showing contaminants detected and relationship to other borings in the site, and cross-sections of the site showing contaminant distribution.

5. The contents and objectives of a Site Characterization Summary Informal Technical Information Report (ITIR) are specified in the Handbook. The Site Characterization Summary ITIR shall serve as a core document for the RI report. The Contractor shall submit an annotated outline of each section of the

ITIR for approval by the TPM prior to preparation of the report itself. The Contractor shall prepare the report as specified in the accepted annotated outline. The Contractor shall submit newly revised portions of the working draft ITIR in order to make available current site characterization data. A prime objective shall be to minimize the volume of comments on the working draft and final submittals by incorporating comments into the report in an on-going manner. The final summary shall contain all sites included in this effort (Sequence No. 4).

h. Weekly Field Activities Report (para 1.3.13). Transmit a Weekly field activities report during field activities pursuant to a format developed by the AFCEE RTC. (Sequence no. 4, para 6.1)

II. Site Location and Dates

Dew Line Sites and Cape Lisburne, date to be established.

III. Base Support The base will:

3.1 Provide the Contractor with existing engineering plans, drawings, diagrams, aerial photographs, digitized map files, etc., to facilitate evaluation of IRP sites under investigation.

3.2 Arrange for personnel identification badges, vehicles passes, and/or entry permits with the contention the Contractor will provide necessary information to the base personnel no less than four weeks before needed.

3.3 Provide the Contractor with all previously approved documents which provide information on all IRP efforts conducted at Dew Line Sites and Cape Lisburne and will aid in the determination of the amount of field work and analyses which need to be conducted.

IV. Government Furnished Property
Not Applicable

V. **Government Points of Contact:**

~~5.1 **MAJCOM Coordinator**~~

~~Major James R. Williams III~~
~~AFCEE/ERD~~
~~8001 Inner Circle DR STE 2~~
~~Brooks AFB TX 78235-5328~~
~~(210) 536-5243~~
~~DSN 240-5243~~
~~(210) 536-9026 FAX~~
~~DSN 240-9026~~

~~5.2 **Restoration Team Chief**~~

~~Mr. Michael F. McGhee~~
~~AFCEE/ERD~~
~~8001 Inner Circle DR STE 2~~
~~Brooks AFB TX 78235-5328~~
~~(210) 536-5293~~
~~DSN 240-5293~~
~~(210) 536-9026 FAX~~
~~DSN 240-9026~~

~~5.3 **Base Point of Contact (POC)**~~

~~Mr. Jim Wolfe~~
~~11 CEOS/CEVR~~
~~21885 Second Street~~
~~Elmendorf AFB AK 99506-4420~~
~~(907) 552-4532~~
~~DSN 317-552-4532~~
~~(907) 552-1533 FAX~~
~~DSN 317-552-1533~~

~~5.4 **Public Affairs Coordinator**~~

~~Ms. Wende Wolf~~
~~11 CEOS/DEVR~~
~~21885 Second Street~~
~~Elmendorf AFB AK 99506-4420~~
~~(907) 552-4532~~
~~DSN 317-552-4532~~
~~(907) 552-1533 FAX~~
~~DSN 317-552-1533~~

VI. Deliverables

6.1 Attachment 1 of the Basic Contract

Sequence numbers 1 and 5 listed in attachment 1 to the basic contract apply to all orders. Guidance for preparing R&D Status Reports (sequence 1) is contained in the Handbook, section 4. In addition, the sequence numbers and dates listed below are applicable to this order:

Sequence No.	Para No.	Block 10 (freq.)	Block 11 (as of date)	Block 12 (date of 1st. submit.)	Block 13 (date of final report)	Block 14 (no. of copies)
3 (NETWORK ANALYSIS)	I.1.4.1a	QTRLY	12APR93	30APR93	a	4
4 (WORK PLAN)	I.1.4.1b	ONE/R	12APR93	30MAY93	30JULY93	b
4 (WORK PLAN ADDENDUM)	I.1.4.1b	ONE/R		2WKSDOA	15SEPT94	m
4 (SAP)	I.1.1.4c	ONE/R	12APR93	30MAY93	30JULY93	b
4 (SAP ADDENDUM)	I.1.4.1c	ONE/R		3WKSDOA	15SEPT94	n
4 (HSP)	I.1.4.1d	OTIME	12APR93	30MAY93	-	10
4 (HSP ADDENDUM)	I.1.4.1d	OTIME		2WKSDOA		5
4 (COMM. REL. PLAN)	I.1.1.4e	ONE/R	12APR93	30MAY93	31DEC93	b
16 (SPECIAL NOTIF.)	I.1.4.2	OTIME	c	c	-	3
9 (PRESNT. MATERIAL)	I.1.4.3	ASREQ	d	d	-	10
18 (MTG. RPTS)	I.1.4.4	ONE/R	e	e	-	5
3 (NEWSLETTER)	I.1.4.5	QTRLY	12APR93	30NOV93	a	f
3 (FACT SHEETS)	I.1.4.6	ASREQ	12APR93	15JUL93	g	-
3 (PUBLIC NOTICES)	I.1.4.7	ASREQ	12APR93	15JUL93	g	h
9 (PHOTO NOTEBOOK)	I.1.4.8	OTIME	12APR93	15JUL93	-	1
3 (MAILING LIST)	I.1.4.9	QTRLY	12APR93	15JUL93	a	-
3 (MAPS)	I.1.4.10	OTIME	12APR93	15JUL93	-	2
4 INFO REPOS	I.1.4.11	OTIME	31JUL93	-	31JAN94	2
3 (IRPMS Data ITIR) (Data Management) BCHCON BCHLDI BCHSLI BCHWCI BCHSAMP BCHCALC BCHLTD BCHTEST BCHRES BCHGWD	I.1.4.12	OTIME	31JUL93	31JAN94	31MAR94	2
4 DECISION DOC	I.1.4.13	ONE/R	i	i	31OCT94	b
4 RI REPORT	I.1.4.14.1	ONE/R	15SEP93	15FEB94	30APR94	b
4 RISK ASSESSMENT	I.1.4.14.2	ONE/R	1OCT93	16MAY94	15JUL94	b
4 FEASIB. STUDY	I.1.4.14.3	ONE/R	30SEPT93	30AUG94	-	b
4 RI/FS Report	I.1.4.14.4	ONE/R	30SEP93	30SEP94	1JAN95	b
4 IRP DOCUMENT	I.14.15	ONE/R	31JUL93	31OCT93	10DEC93	b
3 ANALYTICAL DATA ITIR		OTIME		01DEC94		2
3 SCREENING ALTER ITIR	I.1.4.16a	OTIME	30SEP93	30DEC93	-	10
3 DETAL ANALYSIS ALTER ITIR	I..1.4.16.b	OTIME	28 FEB94	30MAR94	-	10
1 DPM SCORING	I.1.4.16c	OTIME	30SEP93	j	j	3
3 MYLAR MAP	I.1.4.16d	OTIME	k	k	-	5
3 GEOPHYS CONT	I.1.4.16.e	OTIME	l	l	-	10
3 SOIL GAS MAP	I.1.4.16f	OTIME	l	l	-	10
4 SCS ITIR	I.1.4.16g	ONE/R	-	01FEB95	01APR95	o
~~4 SCS ITIR~~	~~I.1.4.16g~~	~~ONE/R~~	~~15SEP93~~	~~30NOV93~~	~~15FEB94~~	~~5~~
4 WEEKLY ACT REP	I.1.4.16h	WEEKLY	13AUG93	13AUG93	-	1

6.2 Reserved.

6.3 Notes

a. Submit Quarterly Thereafter.

b. One (1) first draft plan (8 copies), one (1) second draft plan (8 copies), and one (1) final plan (10 copies) are required. Incorporate Air Force comments into the second draft and final plan as specified by the RTC. Supply AFCEE/ESR with an advance copy of the first draft, second draft, and final plan for acceptance prior to distribution. Distribute the remaining copies of each plan as specified by the RTC. The second and final reports shall be submitted within three (3) weeks of receipt of comments from the RTC.

c. Primary and Secondary Documents. One first draft report (25 copies), one second draft report (25 copies), and one final report (35 bound copies plus the original camera-ready copy and a 3.5 inch disk formatted in WordPerfect 5.1 containing the document file) are required. Incorporate Air Force comments into the second draft and final reports as specified by the RTC. Supply the RTC with an advance copy of the first draft, second draft, and final reports for acceptance prior to distribution. Distribute the remaining copies as specified by the RTC .

d. Provide written notice with supporting documentation within three (3) days of telephone notification and at the direction of the RTC. Assume a maximum of 100 pages.

e. Provide within one (1) week of task/meeting completion.

f. Provide 500 copies of the Newsletters and distribute as agreed to by the RTC. This includes mailing the final product to on-base personnel and addresses on the existing mailing list.

g. Provide draft and final deliverables. Provide two advance copies to the AFCEE RTC and to the 11 CEOS Community Relations Coordinator for acceptance prior to preparation of the final deliverables.

h. Provide poster-size map.

i. Submit with the second draft Technical Report.

j. Submit with the Technical Report.

k. Provide with the Technical Report.

l. Provide within four (4) weeks of task completion.

m. Both a draft and a final addendum to the existing work plan is required for the removal actions specified in paragraph I.1.3.14. Field removal activities performed at Cape Lisburne LRRS pursuant to paragraph I.1.3.14 of this SOW shall commence upon submittal of the draft work plan to AFCEE for review. The Contractor shall distribute both versions of the work plan as specified by AFCEE.

n. The SAP addendum shall focus on the sampling and analysis activities to be conducted under the removal actions specified in paragraph I.1.3.14 of this SOW. The Contractor shall incorporate any Government comments into the final project-specific SAP. The Contractor shall distribute the SAP as specified by AFCEE.

o. A Site Characterization Summary ITIR must be prepared based on the findings of sampling and analyses conducted pursuant to the removal action specified in paragraph I.1.3.14. The Contractor shall incorporate any Government comments into the final ITIR. The Contractor shall distribute the ITIR as specified by AFCEE.

~~**Notes:**~~

~~a Unless an abbreviated list of analytes is specified under "Parameter" above, the analytical protocol shall include all analytes listed in the referenced analytical method. The methods cited are from the following sources:~~

~~"A" Methods — Standard Methods for the Examination of Water and Wastewater, 16th Edition (1985)~~

~~"E" Methods — Methods for Chemical Analysis of Water and Wastes, EPA Manual, 600/4-79-020 (USEPA, 1983--with additions)~~

~~"SW" Methods — Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition (USEPA, 1986)~~

~~"ASTM" Methods — American Society for Testing and Materials, 1919 Race Street, Philadelphia, PA 19103~~

~~b The maximum number of second-column confirmation analyses shall not exceed fifty (50) percent of the actual number of field samples (to include duplicates, replicates, ambient, condition blanks, trip blanks, and equipment blanks). If the number of samples requiring second-column confirmation exceeds this allowance, contact the HSD Technical Project Manager. The total number of samples listed in Tables A-4 and A-5 includes the allowance applicable to each GC method. IF GC/MS, or a combination of second-column GC and GC/MS, is used, the total cost of all such analyses for a particular parameter shall not exceed the funding allowed for positive confirmation using only second-column GC.~~

REF 68X 68X

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. PAGE 1 OF 3

2. PROC INSTRUMENT ID NO. (PIIN)	3. SPIIN	4. EFFECTIVE DATE	5. REQUISITION/PURCHASE REQUEST PROJECT NO.	6. BCC/DMS RATING
F33615-90-D-4010	002205	20SEP94	FY7624-94-08822	

7. ISSUED BY CODE FA8900

DEPARTMENT OF THE AIR FORCE
AIR FORCE MATERIAL COMMAND
HUMAN SYSTEMS CENTER
BROOKS AFB TX 78235-5320

Buyer: EDWIN CUSTODIO HSC/PKVBC
Phone: (210)536-4493

8. ADMINISTERED BY (IF OTHER THAN BLOCK 7) CODE S2404A

DCMAO BALTIMORE
ATTN: CHESAPEAKE
200 TOWSONTOWN BLVD, WEST
TOWSON, MD 21204-5299

DUPLICATE ORIGINAL

9. CONTRACTOR NAME AND ADDRESS CODE 69148 FACILITY CODE

IF "9" FOR MULTIPLE FACILITIES SEE SECT "K"

ICF TECHNOLOGY
9300 LEE HIGHWAY
FAIRFAX VA 22031-1207

PHONE:(703)934-3000
COUNTRY:FAIRFAX

MAIL DATE
SEP 2 3 1994

10. SECURITY CLAS U

11. DISCOUNT FOR PROMPT PAYMENT

1 ST % DAYS
2 ND % DAYS
3 RD % DAYS
NET DAYS
OTHER IF "9" SEE SECT "E"

12. PURCHASE OFFICE POINT OF CONTACT
MVH/M1E/MVH

13. THIS BLOCK APPLIES ONLY TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in block 17. The hour and date specified for receipt of Offers ☐ is extended ☐ is not extended

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation, or as amended by on of the following methods:

(a) By signing and returning ______ copies of this amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE ISSUING OFFICE PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

14. THIS BLOCK APPLIES ONLY TO MODIFICATION OF CONTRACTS

☐ THIS CHANGE IS ISSUED PURSUANT TO ______ THE CHANGES SET FORTH HEREIN ARE MADE TO THE ABOVED NUMBERED CONTRACT/ORDER.

☐ THE ABOVE NUMBERED CONTRACT IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (SUCH AS CHANGES IN PAYING OFFICE, APPROPRIATION DATA, ETC.) SET FORTH HEREIN.

☐ THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF ______ IT MODIFIES THE ABOVE NUMBERED CONTRACT AS SET FORTH HEREIN.

☒ THIS MODIFICATION IS ISSUED PURSUANT TO FAR 52.232-7 PAYMENT UNDER T&M OR LABOR HOURS

15. CONTRACT ADMINISTRATION DATA

A. KIND OF MOD	B. MOD ABST RECIPIENT ADP PT	C. DATE OF SIGNATURE MODIFICATION	D. CHANGE IN CONTRACT AMOUNT INCREASE (+) DECREASE (-)	E. LOSING PO/CAO ON TRANSFER	F. GAINING PO/CAO ON TRANSFER	G. SVC/AGENCY USE
C			$ SEE SECTION G			

16. ENTER ANY APPLICABLE CHANGES

A. PAY CODE	B. EFFECTIVE DATE OF AWARD	C. CONTRACT (1) TYPE (2) KIND	D. TYPE CONTR	E. SURV CRIT	F. SPL CONTR PROVISIONS	G. PAYING OFC CODE	H. DATE SIGNED	I. SECURITY (1) CLAS (2) DATE OF DD 254

17. REMARKS *(Except as provided herein, all items and conditions of the contract, as heretofore changed, remain unchanged and in full force and effect.)* SUBJECT: INCREASE CEILING AMOUNT/ FUND OVERRUN

PROJECT MANAGER: SAMER N. KARMI, AFCEE/ERDW, BROOKS AFB, TX 78235-5328
FINANCE OFFICE:(SC1030)DFAS-COLUMBUS CENTER, DFAS-CO/CHESAPEAKE DIV
COLUMBUS, OH 43218-2262

18. ☒ CONTRACTOR/OFFEROR IS NOT REQUIRED TO SIGN THIS DOCUMENT ☐ CONTRACTOR/OFFEROR IS REQUIRED TO SIGN THIS DOCUMENT AND RETURN COPIES TO ISSUING OFFICE

19. CONTRACTOR/OFFEROR *(Signature of person authorized to sign)*
BY

22. UNITED STATES OF AMERICA *(Signature of Contracting Officer)*
BY

20. NAME AND TITLE OF SIGNER *(Type or print)*

21. DATE SIGNED

23. NAME OF CONTRACTING OFFICER *(Type or print)*
DEAN M. CARSELLO

24. DATE SIGNED
20 SEP 1994

1. Pursuant to FAR 52.232-7 Payment Under Time-and-Material and Labor-Hours Contracts and in accordance with the provisions of the Basic Contract F33615-90-D-4010 and Delivery Order 0022, Mod. 05 the above delivery order is amended. The purpose of this modification is to increase the ceiling amount of this order by $330,000.00 to cover the total cost of the efforts being requested. The ceiling is being increased to cover existing work.

2. As a result of paragraph 1 above, said order is more specifically modified as follows:

a. SECTION A Cover Page: The ceiling amount in Block 20 (cover page) is increased by $330,000.00 from $3,528,878.00 to $3,858,878.00.

b. SECTION B Supplies/Services: is amended as set forth below.

Item No.	Supplies Schedule	Qty Purch Unit	Unit Price
0001	CLIN Change Sec Class: U Noun: Sampling, Analysis, and Data Acrn: XA nsn: N Sites Codes: pqa: D acp: D fob: D		N
0002	CLIN Change Sec Class: U Noun: Support Acrn: XA nsn: N Sites Codes: pqa: D acp: D fob: D		N
0004	CLIN Change Sec Class: U Noun: Chemical Analysis & Data Acrn: XA nsn: N Sites Codes: pqa: D acp: D fob: D		N

pr/mipr data: FY7624-94-08822

b. SECTION G Accounting Classification Data: is amended as set forth below:

ACRN	Acct Class Data	Appropriation/Lmt Subhead/CPN Recip DODAAD Supplemental Accounting Classification		Obligation Amount
AD	Account Establish			$330,000.00
	Unclassified	5743400	F74400	
		304 7434 434419 040000 53475 000000 674400		

pr/mipr data: FY7624-94-08822 (PR Complete)

descriptive data: AF Form 616 H94-SR-365 dated: 18 Aug 94 expiration: 22 Sep 94

XA Special ACRN Establish

descriptive data: Special ACRN XA Funds CLINs 0001, 0002, and 0004 and includes the following:

AA:	$ 299,855.00	(Basic DO)
AB:	99,986.00	(Mod. -01)
	2,899,511.00	(Mod. -02)
AC:	229,526.00	(Mod. -04)
AD:	330,000.00	(Mod. -05)
TOTAL	$3,858,878.00	

Finance Officer: Pay funds in alphabetical order.

3. Concurrence to this Unilateral Agreement is evidenced by contractor's (ICF) letter dated 8 Jun 94, incorporated herein by reference.

4. All other terms and conditions remain unchanged and in full force and effect.

REF 68X

68X

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. PAGE 1 OF 4

2. PROC INSTRUMENT ID NO. (PIIN)	3. SPIIN	4. EFFECTIVE DATE	5. REQUISITION/PURCHASE REQUEST PROJECT NO.	6. DOC/DMS RATING
F33615-90-D-4010	002206	27MAR95	FY7624-95-08452	DO-C9

7. ISSUED BY CODE FA8900

DEPARTMENT OF THE AIR FORCE
AIR FORCE MATERIEL COMMAND
HUMAN SYSTEMS CENTER
8005 9TH STREET
BROOKS AFB TX 78235-5353
Buyer: EDWIN CUSTODIO /PKVBA
Phone: (210) 536-4493

8. ADMINISTERED BY (IF OTHER THAN BLOCK 7) CODE S2404A

DCMAO BALTIMORE
ATTN: CHESAPEAKE
200 TOWSONTOWN BOULEVARD, WEST
TOWSON MD 21204-5299

9. CONTRACTOR NAME AND ADDRESS CODE 69418 FACILITY CODE

IF "Y" FOR MULTIPLE FACILITIES SEE SECT "K"

ICF TECHNOLOGY, INC.
9300 LEE HIGHWAY
FAIRFAX, VA 22301-3000

COUNTY: FAIRFAX
PHONE: (703)934-3000

ADVANCE COPY

10. SECURITY CLAS U

11. DISCOUNT FOR PROMPT PAYMENT

1 ST % DAYS
2 ND % DAYS
3 RD % DAYS
NET DAYS
OTHER IF "Y" SEE SECT "E"

12. PURCHASE OFFICE POINT OF CONTACT

MVH/M1U/MVH

13. THIS BLOCK APPLIES ONLY TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in block 17. The hour and date specified for receipt of Offers ☐ is extended ☐ is not extended

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation, or as amended by one of the following methods:

(a) By signing and returning ______ copies of this amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE ISSUING OFFICE PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

14. THIS BLOCK APPLIES ONLY TO MODIFICATION OF CONTRACTS

☐ THIS CHANGE IS ISSUED PURSUANT TO ______ THE CHANGES SET FORTH HEREIN ARE MADE TO THE ABOVE NUMBERED CONTRACT/ORDER.

☐ THE ABOVE NUMBERED CONTRACT IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (SUCH AS CHANGES IN PAYING OFFICE, APPROPRIATION DATA, ETC.) SET FORTH HEREIN.

☐ THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF ______ IT MODIFIES THE ABOVE NUMBERED CONTRACT AS SET FORTH HEREIN.

☒ THIS MODIFICATION IS ISSUED PURSUANT TO IAW FAR 52.232-7 PAYMENT UNDER T&M AND LABOR HOURS

15. CONTRACT ADMINISTRATION DATA

A. KIND OF MOD	B. MOD ABST RECIPIENT ADP PT	C. DATE OF SIGNATURE MODIFICATION	D. CHANGE IN CONTRACT AMOUNT INCREASE (+) DECREASE (-)	E. LOSING PO/CAO ON TRANSFER	F. GAINING PO/CAO ON TRANSFER	G. SVC/AGENCY USE
B			$ SEE SECTION G			

16. ENTER ANY APPLICABLE CHANGES

A. PAY CODE	B. EFFECTIVE DATE OF AWARD	C. CONTRACT (1) TYPE (2) KIND	D. TYPE CONTR	E. SURV CRIT	F. SPL CONTR PROVISIONS	G. PAYING OFC CODE	H. DATE SIGNED	I. SECURITY (1) CLAS (2) DATE OF DD 254

17. REMARKS (Except as provided herein, all items and conditions of the contract, as heretofore changed, remain unchanged and in full force and effect.) SUBJECT: INCREASE TO THE CONTRACT CEILING PRICE

PROJECT MANAGER: SAMER KARMI, AFCEE/ERD, BROOKS AFB TX 78235-5353
FINANCE OFFICE: (SC1030) DFAS-COLUMBUS CENTER, DFAS-CO/CHESAPEAKE DIV
P O BOX 182264, COLUMBUS OH 43218-2264

18. ☒ CONTRACTOR/OFFEROR IS NOT REQUIRED TO SIGN THIS DOCUMENT ☐ CONTRACTOR/OFFEROR IS REQUIRED TO SIGN THIS DOCUMENT AND RETURN ______ COPIES TO ISSUING OFFICE

19. CONTRACTOR/OFFEROR (Signature of person authorized to sign)

BY

22. UNITED STATES OF AMERICA (Signature of Contracting Officer)

BY Janelle J. Larrison

20. NAME AND TITLE OF SIGNER (Type or print)

21. DATE SIGNED

23. NAME OF CONTRACTING OFFICER (Type or print)

JANELLE J. LARRISON

24. DATE SIGNED

95 Mar 27

1. Pursuant to FAR 52.232-7 Payment Under Time-and-Material and Labor-Hours Contracts and in accordance with the provisions of the Basic Contract F33615-90-D-4010 and Delivery Order 0022, Mod. 06 the above delivery order is amended. The purpose of this modification is to increase the ceiling amount of this order by $315,000.00 to cover the total cost of the efforts being requested. The ceiling is being increased to cover existing work in the revised Work Plan.

2. As a result of paragraph 1 above, said order is more specifically modified as follows:

a. SECTION A Cover Page: The ceiling amount in Block 20 (cover page) is increased by $315,000.00 from $3,858,878.00 to $4,173,878.00.

b. SECTION B Supplies/Services: is amended as set forth below.

Item No.	Supplies Schedule	Qty Purch Unit	Unit Price
0001	CLIN Change Sec Class: U Noun: Sampling, Analysis, and Data Acrn: XA nsn: N Sites Codes: pqa: D acp: D fob: D		N
0002	CLIN Change Sec Class: U Noun: Support Acrn: XA nsn: N Sites Codes: pqa: D acp: D fob: D		N
0004	CLIN Change Sec Class: U Noun: Chemical Analysis & Data Acrn: XA nsn: N Sites Codes: pqa: D acp: D fob: D		N

pr/mipr data: FY76-95-08452

c. SECTION F Supplies schedule Data: The delivery schedule is modified as set forth below:

Item No.	Supplies Schedule Data		Delivery Quantity	Schedule Date
0001	CLIN Del Sch Change acrn: XA ship to: U	Sec Class: U	1	96 Jan 31
0002	CLIN Del Sch Change acrn: XA ship to: U	Sec Class: U	1	96 Jan 31
0004	CLIN Del Sch Change acrn: XA ship to: U	Sec Class: U	1	96 Jan 31

b. SECTION G Accounting Classification Data: is amended as set forth below:

ACRN	Acct Class Data	Appropriation/Lmt Subhead/CPN Recip DODAAD Supplemental Accounting Classification	Obligation Amount
AE	Account Establish Unclassified	 5753400 F74400 305 7434 434419 040000 53440 000000 674400	$315,000.00

pr/mipr data: FY7624-95-08452 (PR Complete)

descriptive data: AF Form 616 H95-SR-298 dated: 1 Mar 95, expiration 15 Sep 95.

XA Special ACRN Establish

descriptive data: Special ACRN XA Funds CLINs 0001, 0002, and 0004 includes the following:

AA:	$ 299,855.00	(Basic DO)
AB:	99,986.00	(Mod.-01)
	2,899,511.00	(Mod.-02)
AC:	229,526.00	(Mod.-04)
AD:	330,000.00	(Mod.-05)
AE:	315,000.00	(Mod.-06)
	$4,173,878.00	

Finance Officer: Pay funds in alphabetical order.

3. Concurrence to this Unilateral Agreement is evidenced by contractor's (ICF) letter dated 18 Jan 95, incorporated herein by reference.

4. All other terms and conditions remain unchanged and in full force and effect.